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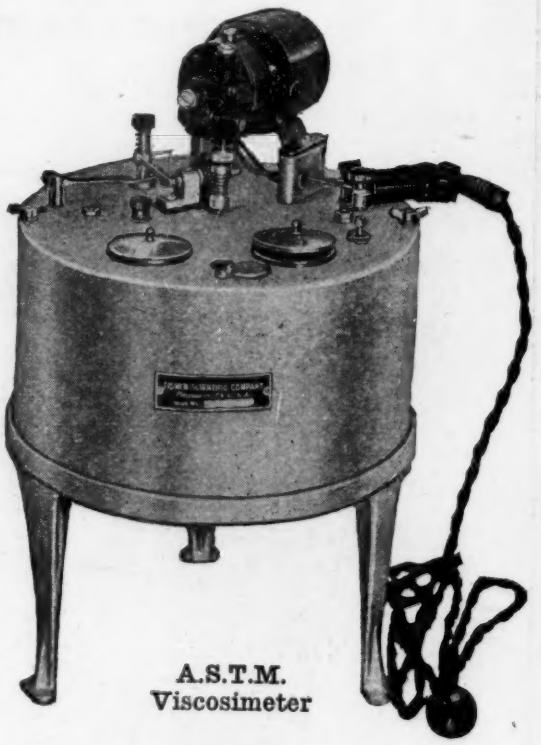

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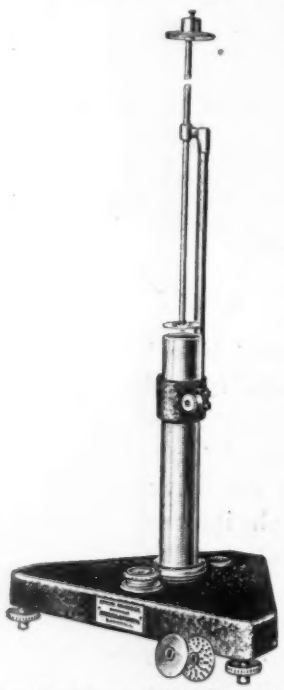

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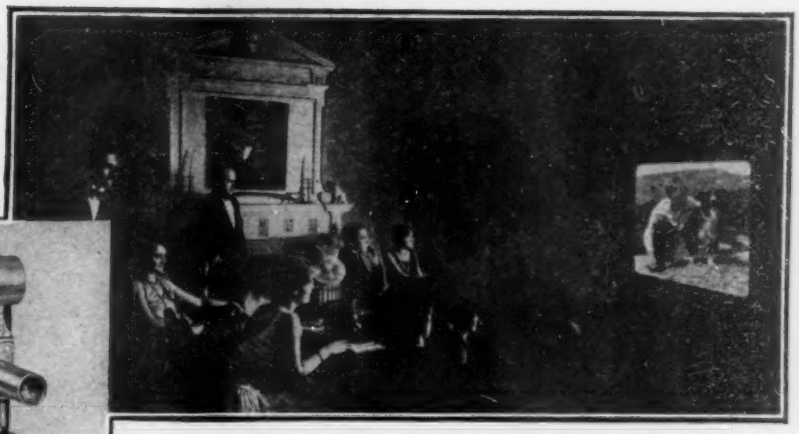

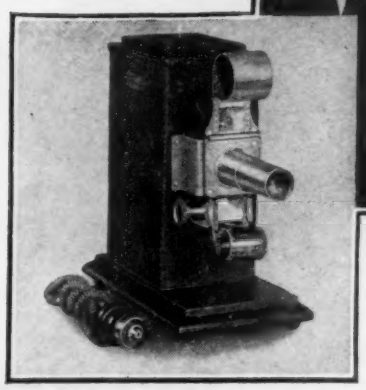

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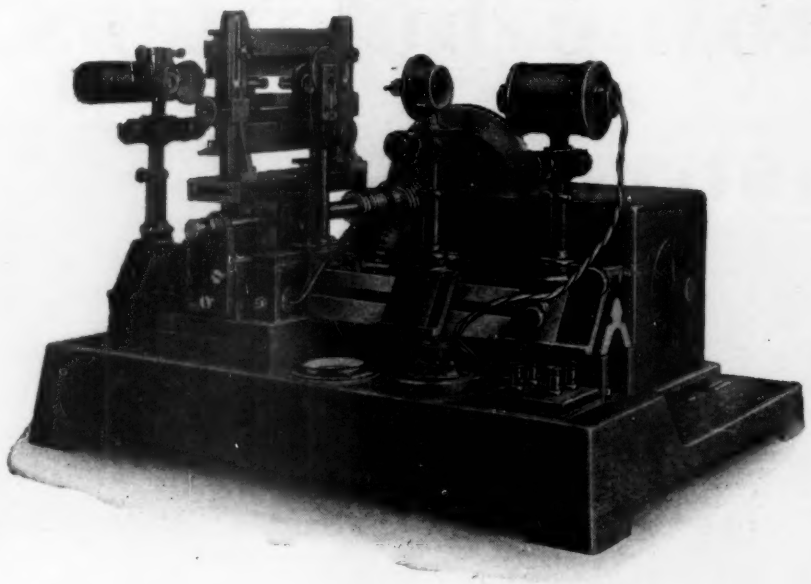

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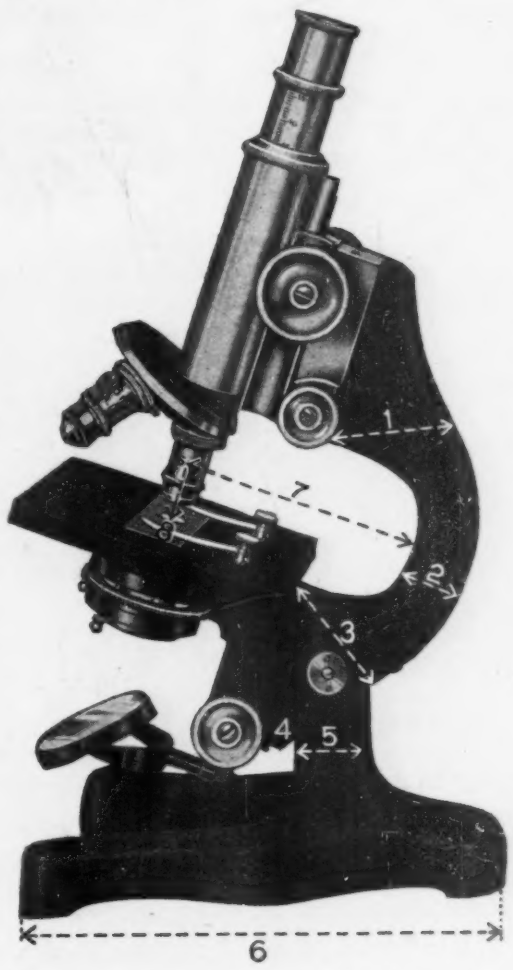

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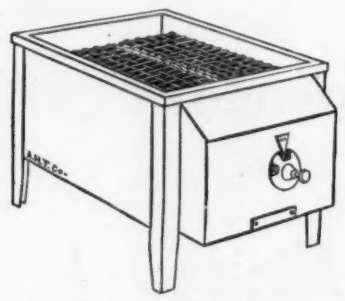

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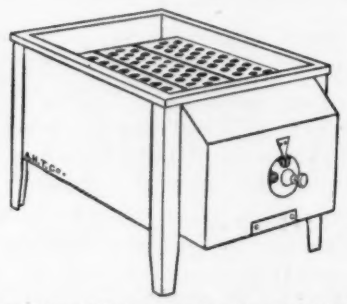

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MR. HOOVER'S TRIBUTE TO MR. EDISON[1]

THIS ceremony is a part of the celebration of Mr. Edison's invention of the electric lamp. It is also the dedication of the Edison Institute of Technology, the gift of Mr. Ford. Both are in fact national tributes to Mr. Edison.

The multiplication of the amount of light in the world a thousandfold is worthy of celebration, for darkness is a forbidding limitation upon righteous human activities.

When Mr. Edison invented the electric lamp he may perhaps have thought just to produce plain light and more of it at less cost. I surmise that his wildest ambition was to relieve the human race from the curse of always cleaning oil lamps, scrubbing up candle drips and everlastingly carrying one or the other of them about. He may have thought to add safety to Chicago against a second accident from an oil lamp.

But the electric lamp has found infinite variety of unexpected uses. It enables us to postpone our spectacles for a few years longer; it has made reading in bed infinitely more comfortable; by merely pushing a button we have introduced the element of surprise in dealing with burglars; the goblins that lived in dark corners and under the bed have now been driven to the outdoors; evil deeds which inhabit the dark have been driven back into the farthest retreats of the night; it enables the doctor to peer into the recesses of our insides; it substitutes for the hot-water bottle in aches and pains; it enables our cities and towns to clothe themselves in gaiety by night, no matter how sad their appearance may be by day.

And by all its multiple uses it has lengthened the hours of our active lives, decreased our fears, replaced the dark with good cheer, increased our safety, decreased our toil and enabled us to read the type in the telephone book. It has become the friend of man and child.

In making this, as in his other great inventions, Mr. Edison gave an outstanding illustration of the value of the modern method and system of invention, by which highly equipped, definitely organized labora-

[1] Address given at Dearborn, Michigan, on October 21.

tory research transforms the raw material of scientific knowledge into new tools for the hand of man.

In earlier times, mechanical invention had been the infrequent and haphazard product of genius in the woodshed. But science has become too sophisticated a being to be wooed in such surroundings. Nowadays a thousand applied science laboratories, supported by industries of our country, yearly produce a host of new inventions.

I can perhaps illustrate this modern method of invention. The fundamental natural laws of electricity were discovered three quarters of a century ago by Faraday, Hertz, Maxwell and other great investigators in the realms of pure physics and mathematics. Faraday discovered that energy could be transformed into electricity through induction—the theory of the electrical generator. It was one of the momentous discoveries of history.

It is related that Mr. Gladstone was induced to visit Faraday's laboratory to see this new scientific contraption. When Gladstone is said to have made the characteristic practical man's inquiry, "Will this ever be of use to mankind?" Faraday replied, "Some day you will collect taxes from it."

Mr. Edison, using organized systematic laboratory research, has been one of the great leaders who have converted the pure physics of electricity into a taxable product. To-day the governments of the world levy upon upward of $60,000,000,000 of new wealth founded upon electricity.

But the taxes and new wealth are not the major accomplishments of the men of this genus. These are the rivers of sweat saved from the backs of men and the infinite drudgery relieved from the hands of women.

I may emphasize that both scientific discovery and its practical application are the products of long and arduous research. Discovery and invention do not spring full-grown from the brains of men. The labor of a host of men, great laboratories, long, patient, scientific experiment build up the structure of knowledge, not stone by stone, but particle by particle. This adding of fact to fact some day brings forth a revolutionary discovery, an illuminating hypothesis, a great generalization or a practical invention.

Research both in pure science and in its application to the arts is one of the most potent impulses to progress. For it is organized research that gives daily improvement in machines and processes, in methods of agriculture, in the protection of health and in understanding. From these we gain constantly in better standards of living, more stability of employment, lessened toil, lengthened human life and decreased suffering. In the end our leisure expands, our interest in life enlarges, our vision stretches. There is more joy in life.

It is the increasing productivity of men's labor through the tools given us by science that shattered the gloomy prophecies of Malthus.

More than a century ago that great student held that increasing population would outrun the food supply and starvation was to be the inevitable executioner of the overcrowded earth.

But since his day we have seen the paradox of the growth of population far beyond anything of which he ever dreamed, coupled at the same time with constantly increasing standards of living and ever-increasing surplus of food. Malthus was right except for a new contestant in the race with his principle: That was more scientific research, more discovery. And that race is still on. If we would have our country improve its standards of living and at the same time accommodate itself to increasing population we must maintain on an even more liberal scale than ever before our great laboratories of both pure and applied science.

Our scientists and inventors are amongst our most priceless national possessions. There is no sum that the world could not afford to pay these men who have that originality of mind, that devotion and industry to carry scientific thought forward in steps and strides until it spreads to the comfort of every home; not by all the profits of all the banks in the world can we measure the contribution which these men make to our progress.

And they are the least interested in the monetary results. Their satisfactions are in their accomplishment—in the contribution of some atom of knowledge which will become part of the great mechanism of progress. Their discoveries are not the material for headlines. Their names are usually known but to a few. But the nation owes them a great honor and is proud to demonstrate through Mr. Edison to-day that their efforts are not unappreciated.

The country can well pay its tribute to the men of this genus by expanding the facilities for their labors. The nation to-day needs more support for research. It needs still more laboratories. To that Mr. Ford is making a generous contribution.

And in establishing this institute, Mr. Ford is doing honor to Mr. Edison in a manner which appeals to a sense of fitness—that is, by founding an institution dedicated to education and scientific research.

And scientific research means more than its practical results in increased living comfort. The future of our nation is not merely a question of the development of our industries, of reducing the cost of living, of multiplying our harvests or of larger leisure. We must constantly strengthen the fiber of national life by the inculcation of that veracity of thought which springs from the search for truth. From its

pursuit we shall discover the unfolding of beauty, we shall stimulate the aspiration for knowledge, we shall ever widen human understanding.

Mr. Edison has given a long life to such service. Every American owes a debt to him. It is not alone a debt for great benefactions he has brought to mankind, but also a debt for the honor he has brought to our country. Mr. Edison by his own genius and effort rose from modest beginnings to membership among the leaders of men. His life gives renewed confidence that our institutions hold open the door of opportunity to all those who would enter.

Our civilization is much like a garden. It is to be appraised by the quality of its blooms. In degree as we fertilize its soil with liberty, as we maintain diligence in cultivation and guardianship against destructive forces, do we then produce those blossoms, the fragrance of whose lives stimulates renewed endeavor, gives to us the courage to renewed effort and confidence of the future.

DR. WILLIAM BEAUMONT, AN APPRECIATION[1]

By WALTER R. STEINER, M.D.

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IT is indeed a privilege to be able to come here to give some words of appreciation in memory of the physician whom you honor to-day—one who by his study of the physiology of digestion has been proved to be a pathfinder in our present knowledge of this subject. He has blazed a trail which has now become a broad highway, and it is greatly to his credit that he did so without any previous scientific training, for he was without college or medical school degrees or preliminary hospital experience. In spite of this, however, his name even now looms up large amongst the most distinguished men in our profession. In 1900 a monument was erected to him by the Upper Peninsular and Michigan State Medical Societies at Fort Mackinac where Beaumont performed his initial experiments upon digestion, but he did not obtain his proper honors until Osler told about him in an inimitable fashion "and brought him out of the obscurity into which we practical moderns had been allowing him to drift." Since then his manuscripts and papers have been presented by his family to Washington University at St. Louis, where, housed in a special room, they are well exhibited and permanently preserved. A boulder with a suitably inscribed bronze tablet was erected in 1926 by the Beaumont Club on the green in Lebanon, the town of his birth, and at the meeting of the Thirteenth International Congress of Physiologists in Boston his book, reprinted for that special occasion, was distributed to the members of the congress as representing our country's foremost contribution to physiology. Surely a prophet is not without honor even in his own country, despite the adage to the contrary, for to-day you are to dedicate a tablet to him here in this town where he conducted two of his four series of experiments.

[1] An address delivered at the unveiling of a tablet to Beaumont at Plattsburgh on August 24, 1929, upon the termination of the summer course in cardio-nephritis at the Physicians Hospital of Plattsburgh, New York.

Our knowledge of the digestive processes before his illuminating study was vague and unsatisfactory. Two views chiefly prevailed—the mechanical and the chemical. The former considered the grinding or pressing force of the muscular coats of the stomach as largely sufficient to accomplish the required and subsequently obtained digestion, while the second view explained the change taking place in the stomach as chiefly, if not wholly, of a chemical nature, resulting from the process of fermentation. Unable to solve the exact nature of digestion, which had stretched the pia mater of so many distinguished physicians, William Hunter, of London, finally remarked, in the century of Beaumont's birth: "Some physiologists will have it that the stomach is a mill, others that it is a fermenting vat, others again that it is a stew pan, but in my view of the matter, it is neither a mill, a fermenting vat, nor a stew pan but a stomach, gentlemen, a stomach."

Before the new era, however, which Beaumont was about to usher in, there were some honest seekers after the truth, and foremost among them we find Benjamin Richardson Young, of Hagerstown, Maryland, a young man like Beaumont and also an American. It had been long known that the gastric juice was acid in reaction, but it remained for Young to take the fundamental step in demonstrating its acidity and in proving its solvent, anti-putrefactive properties. This he did in a thesis which he presented at the University of Pennsylvania for the degree of M.D. in 1803. In the experiments there recorded he introduced a calculus into a frog's stomach and noted its gradual dissolution. He also put beans, peas, wheat and bread into a frog's stomach and found that in thirty hours the beans, peas and wheat were not acted upon, but the bread bag was empty. However, if the cereals were crushed they were readily digested. Vinous, acetous and putrefactive fermentations were then successively investigated with the re-

sult that he showed that the acid in the stomach did not come from any of these varieties. He proved also that trituration and putrefaction were not essentially concerned. Unfortunately, he concluded that the acid was phosphoric and not hydrochloric. He experimented both upon animals and man, securing pure gastric juice to use *in vitro*. Finally he showed that the acid gastric juice checked putrefaction. He explained the process of digestion as follows: "Aliment is dissolved by the gastric menstruum; it then passes into the duodenum and meets with bile and pancreatic liquor; after being united with these, a heterogeneous mass is formed called chyme, and from this the lacteals secrete chyle." Returning to Hagerstown, Maryland, after graduation he was taken by his father into partnership for the practice of medicine, but unfortunately died of tuberculosis about eleven months later.

Three years after Young's birth, there was born in Lebanon, Connecticut, in 1785, William Beaumont, fifth in descent from one of the same name who probably came to Massachusetts in 1635 and migrated with John Winthrop, Jr., to Connecticut. At any rate, he appears in Saybrook in 1640. Our Beaumont was the third son of Samuel Beaumont, being born in a town where Connecticut's distinguished Revolutionary War governor, Brother Jonathan Trumbull, resided, as well as William Williams, a signer of the Declaration of Independence. The town had passed through stirring times during the Revolution, for here Washington and Trumbull had had frequent conferences upon important matters of state, and here De-Lauzun's Cavalry, the French Legion of Horse, was stationed for seven months during 1780 and 1781.

Little is known of Beaumont's boyhood other than the statement that courage and fearlessness were even then his predominating qualities and that defective hearing first developed after he had taken a dare and stood nearer a cannon that was being fired than any of the playmates. He seems to have industriously tilled the soil and assiduously attended church until the winter of 1806–07, when growing tired of these activities he set out northward with a horse, a cutter, a barrel of cider and $100 of hard-earned money. Finally he arrived at the village Champlain, New York, in the spring of 1807 and began teaching school in that town. While thus teaching school and tending store, he began to study medicine with Dr. Seth Pomeroy, and in the fall of 1810, after three years of such study, crossed Lake Champlain to St. Albans to be instructed further by Dr. Benjamin Chandler.

On the second of June, 1812, he secured a license from the Third Medical Society of the State of Vermont, and on September 13, entered the army as surgeon's mate, receiving his commission on December 2, 1812. On account of the inactivity of the division of the army to which he was assigned, he began the private practice of medicine in Plattsburgh on January, 1813, and continued in this practice until February 13 of that year when he again resumed his army career. His efficient work here is worthy of note and his bravery under fire in the battle of Plattsburgh was highly commented upon, along with that of the other surgeon's mates, by Hospital Surgeon James Mann. Soon after the war of 1812 he resigned from the army and entered partnership with Dr. George Senter, announcing to the public in the Plattsburgh *Republican*, December 15, 1815, that they had commenced business in the line of their profession (physic and surgery). They also state that they have opened a store containing a general assortment of drugs, medicines, groceries, dye woods, etc., which they calculate to sell on liberal terms for cash or approved credit. In a postscript to this advertisement it is stated that medicines, etc., will be put up with accuracy and care. This partnership, however, was dissolved a few months later as Dr. Senter had to go south, and the firm became Beaumont and Wheelock. The same newspaper then records the fact that these two have received and offer for sale at the lowest prices a large and well-selected assortment of groceries, consisting of Madeira, Port, London Particular and Sherry, Wines, Cognac and French Brandy—Jamaica, St. Croix and New England Rum—Pierpont ginger, Plug and Paper Tobacco, Pipes, Codfish, Shad, Mackerel, Chocolates, Spanish Segars, Window glass, Snuff, Starch, Powder, Shot Almonds, etc. Also in addition to their former stock they had a large assortment of Drugs and Medicine, Dye Woods, etc., etc. (September 6, 1816). This business, however, was probably not very appealing to Beaumont, and the firm sold out in about a year to Springer and Woodward. Beaumont then confined himself to the practice of medicine, which evidently soon became quite lucrative as his case records show. But the charm of army life was more enticing to him; his friend, Joseph Lovell, had lately been appointed surgeon-general, and the medical corps of the army had been completely reorganized. He consequently accepted the appointment of post surgeon on March 18, 1820, to take rank from December 4, 1819. He was then ordered to Fort Mackinac, Michigan, and two years later married Mrs. Deborah Platt, of Plattsburgh.

On June 6, 1822, the great opportunity came which subsequently made him famous, for on that day a gun was accidently discharged in the retail store of the American Fur Company, and immediately a French Canadian, Alexis St. Martin, fell to the floor with a

perforated gun shot wound in the upper abdomen. Dr. Beaumont was at once sent for and arrived shortly. He found the patient had just been placed on a cot and the helpers were taking off some of his clothing. The wound seemed to be a mortal one, but Beaumont extracted part of the shot and pieces of clothing, remarking as he dressed the wound, "The man can't live thirty-six hours." But he did survive in spite of the permanent hole in his stomach, and was taken to the fort hospital as soon as he could be moved so that Dr. Beaumont could give him better attention. Two years later the county refused any further assistance to St. Martin and Beaumont took him into his own family from "mere motives of charity and a disposition to save life or at least to make him comfortable." Straightway he improved continually in health so that by June 1, 1824, he was able to perform "any kind of labor from the whittling of a stick to the chopping of logs." This kind treatment of St. Martin was performed when Beaumont's salary was $40 a month with two to four rations daily to supply his needs as well as his family's and St. Martin's. In the fall of that year Beaumont sent a report of this case to Surgeon-General Lovell so that he could correct and publish it in some reputable journal, if he saw fit. In 1825 this article appeared in the Medical Recorder, but unfortunately Joseph Lovell's name was appended to it as its author and the error was not corrected until later in that year.

Experimental work upon the patient apparently was not considered until three years after the accident. Four series of experiments were subsequently conducted, the first being communicated to the Michigan Medical Society in 1827. Unfortunately, St. Martin disappeared shortly thereafter and a two-year search was required to discover him. Then a two-year further study follows, and again from November, 1832, to March, 1833, additional research was done upon him. These three studies finally appeared in the fall of 1833 in book form under the title of "Experiments and Observations on the Gastric Juice and the Physiology of Digestion." In this book of 280 pages, 238 experiments are noted, which are so exact that with the exception of pepsin but little has been added since. The first experiments (four in number) were made at Plattsburgh, although he had previously begun experiments in a desultory way at both Fort Mackinac and Fort Niagara, while the second (fifty-six in number) were conducted at Fort Crawford, Prairie du Chien, Wisconsin. The third (116 in number) were recorded in Washington, and finally the fourth (sixty-two in all) from July 9 to November 1, 1833, were performed in Plattsburgh, following the completion of the manuscript of his book. This series is published at the end of the volume.

This book was printed at Plattsburgh by Frederick P. Allen, and reissued the following year by Lilly, Waite and Company of Boston. Four years later an English edition was published by Sir Andrew Combe, of Edinborough, and in 1834 a German edition had appeared. A second edition was also published in Burlington, Vermont, in 1847 by Dr. Samuel Beaumont, William Beaumont's cousin. This edition was a reprint of the first with a good many minor corrections. In the preface Beaumont writes: "I submit a body of facts which can not be invalidated. My opinions may be doubted, denied or approved, according as they conflict or agree with the opinions of each individual who may read them; but their worth will be best determined by the foundation on which they rest —the incontrovertible facts." He recognized that the secretions of gastric juice and mucus in the stomach were essentially dissimilar in their physical and chemical properties; that the agent of chymification was the gastric juice; that this gastric juice was a clear, transparent, odorless, salty and perceptibly acid liquid, capable of being kept pure for months and perhaps years and of checking the process of putrefaction; it possessed the property of coagulating albumen in an eminent degree: its secretion was not free in the stomach but was excited by food or other irritants; its acidity was due to hydrochloric acid and it possessed also some other active chemical principles; it became intimately mixed and blended with the food by the muscular activity of the stomach, the ultimate principles of aliment being always the same. He realized that the quantity of food consumed was generally more than the system required and that if such excess was persevered in functional abberration and finally disease of the coats of the stomach would ensue. Nutriment as well as bulk were required in a diet, and oily substances retarded digestion, but the digestion of such substances was facilitated in the intestines by bile which was not ordinarily found in the stomach. From three to three and a half hours were usually required for the digestion of a meal. Stimulating condiments and ardent spirits were conducive to disease of the stomach. Chyme when expelled from the stomach into the intestines became chyle which then was acted upon by the bile and pancreatic fluid. Finally, Beaumont declared that no other liquid produced the same effects on food as gastric juice.

In the course of his study he sent specimens of the gastric juice to Professor Robley Dunglism, of the University of Virginia, and Professor Benjamin Silliman, of Yale, two of the foremost scientists in this country, hoping that they might throw some light on some of his observations and render him some assistance. The latter indeed, desiring to aid him, sent

a sample to Professor Jacob Berzelius, the famous Swedish chemist, at Stockholm, but none of their answers were especially illuminating. In spite of this disappointment he showed in his book an extensive knowledge of the literature of the physiology of digestion, and by his researches he is clearly a pioneer. The most important of his findings have been corroborated by Pavlov and others. Small matter is it that he failed to realize that contractions were associated with the pangs of hunger or that the seat of hunger was in the nervous system. He did not discover the existence of reflex or psychic secretion, or that of a continuous and constant secretion, or comprehend the function of saliva in digestion. He also missed the storage function of the stomach, but he paved the way for these and other findings by subsequent investigators.

His remaining years are soon recorded. He resigned from the army in 1839, as Lovell's successor. Dr. Thomas Lawson, not discerning properly the importance of Beaumont's investigations, had ordered him sent to Florida. The acceptance of this post was obviously impossible, so Beaumont, resigning from the army, settled in St. Louis. Here he soon acquired an extensive practice and was busily engaged therein until an accident hastened his death, which occurred on April 25, 1853. His remains rest in the Bellefontaine Cemetery in St. Louis, but his fame belongs to the world.

The following estimate of him was written by one who knew him well:

> He was gifted with strong natural powers, which, working upon an extensive experience in life, resulted in a species of natural sagacity, which, as I suppose, was something peculiar in him, and not to be attained by any course of study. His temperament was ardent, but never got the better of his instructed and disciplined judgment, and whenever or however employed, he ever adopted the most judicious means of attaining ends that were always honorable. In the sick-room he was a model of patience and kindness; his intuitive perceptions, guiding a pure benevolence, never failed to inspire confidence, and thus he belonged to that class of physicians whose very presence afford nature a sensible relief.

May this appropriately inscribed tablet recall to coming generations in Plattsburgh the memory of this most distinguished man, for here he entered the army, here he began the practice of medicine among its inhabitants, here he married his wife and here he conducted two of his now world-famous series of experiments upon the physiology of digestion.

TEN YEARS OF STATISTICAL STUDIES OF MARINE PHYTOPLANKTON AT THE SCRIPPS INSTITUTION OF OCEANOGRAPHY

By Professor WINFRED EMORY ALLEN

SCRIPPS INSTITUTION OF OCEANOGRAPHY

Introductory

This work was begun in July, 1919, at the invitation and recommendation of Dr. W. E. Ritter, at that time director of the Scripps Institution for Biological Research which later became the Scripps Institution of Oceanography of the University of California. My preliminary survey of possibilities in the summers of 1917 and 1918 had indicated that diatoms and dinoflagellates constituted material fairly favorable for statistical studies, and that arrangements for handling this material effectively could be made more satisfactorily than for any other organisms in the ocean plankton. My original assumption was that the work should be carried with a continuity as high as practicable over a period of at least ten years.

Purposes

The fundamental purpose in mind at the beginning of these investigations was to obtain definite series of records of distribution in time and space of diatoms and dinoflagellates as major groups of microplankton organisms. Incidental to the accumulation of such records and consequent to appropriate stages in that accumulation an indefinite number of dependent and interdependent aims was recognized. As examples of these a few may be mentioned as follows:

To determine relative prominence of constituent organisms in general or in particular localities.
To estimate ranges of productivity of particular localities or depth levels or time periods.
To characterize fluctuations in character of populations.
To identify observable causes of specific prominence.
To identify normal trends and periodic series in natural history of the oceanic complex.
To determine observable interrelationships of organisms and their environment.
To determine observable influences involved in stabilizing or destabilizing such interrelationships.
To identify indicators of environmental influences.
To identify food chains.
To identify injurious species of diatoms and dinoflagellates.

SOURCES OF MATERIAL

My original intention was to confine investigations mainly to Southern California material, on the assumption that local collections could be more certainly obtained with a continuity sufficient to be dependable for distributional studies. But, for a number of reasons, material from other regions has accumulated to an extent more than half that from Southern California sources. One series of collections in the East Pacific was carried as far south as Callao, Peru, one extended across the Pacific to Australia, two or three short series were obtained in the Hawaiian region, several in the Alaskan region, several between San Francisco and Puget Sound and several south of San Francisco to the Gulf of California. Alongshore stations for daily collecting have been occupied ten years at La Jolla, nearly ten years at Pt. Hueneme (near Ventura), six years at Oceanside, two years at Balboa (south of Long Beach), four years at Farallone Islands and three years at Scotch Cap Light in the Aleutian Islands.

A much larger number of collections has been obtained inshore than was taken offshore or on the high seas because of the greater ease of maintaining continuity in the series. Judging from the willingness to cooperate shown by officials and officers of the U. S. Navy, U. S. Coast and Geodetic Survey, U. S. Bureau of Lighthouses, mercantile vessels and private yachts, it would have been easy to obtain surface collections by institution methods in numbers of thousands per year for the past ten years. Some of these would have had continuity to an important degree though not so dependable as that of the daily collections at inshore stations. But the laboratory resources of the institution have been too narrowly limited to encourage their accumulation.

Relatively few series of collections for phytoplankton study have been obtained from levels below the surface of the sea. Most of these have been from stations near La Jolla and San Diego, but a few to depths of sixty meters have been made as far north as Santa Barbara by the institution boat and in Monterey Bay by Dr. H. B. Bigelow. Certain series at La Jolla have been carried to a depth of one hundred meters.

NUMBERS OF CATCHES

A few series of collections have been short, including only twenty to fifty catches, but most have included from one hundred to six hundred catches. The total number of catches obtained in the ten years by the measured water method has reached almost twenty thousand. Of these, over twelve thousand have been taken in the Southern California region, nearly two thousand in Alaskan waters, about four thousand from central California to Puget Sound and over one thousand from other regions. Reports have been written and published for studies of about twelve thousand catches.

Relatively few of these catches have been large, probably not a hundred reaching one million cells per liter, and probably not a thousand reaching one hundred thousand cells per liter. However, it should be noted that any method involving rapid filtration may permit escape of large numbers of smaller diatoms and dinoflagellates, especially in thin or median populations.

METHODS OF COLLECTING AND EXAMINING MATERIAL

From previous experience with fresh-water plankton and with preliminary studies on marine plankton it was recognized at the first that methods of collecting distinctly different from those of the tow-net must be adopted. After several weeks of study and experiment it was decided to use the method of filtering a measured volume of water by pouring it through a small conical net of No. 25 bolting silk (diameter of mesh openings about 50 to 100 micra). This method has been used almost exclusively in obtaining phytoplankton material for the institution since September, 1919. At the surface level the selected quantity of water has been dipped up by a pail at fixed stations and by a canvas bucket from steamers at full speed. At subsurface levels closing bottles have been used, mainly those designed by Kofoid or by Allen.

Centrifuges have been used to some extent, mainly for records of volume. In one series no filtration or condensation was attempted, the abundance of diatoms being so great that it was easier to estimate numbers by examination of the water as dipped from the surface of the sea. At present a series of collections parallel to the regular La Jolla pier series is being obtained by allowing the plankton material to settle in one liter of sea-water after adding a killing fluid.

The Allen closing bottle of five liters capacity was originally designed for use by hand from a rowboat, but it was found so convenient and satisfactory in routine boat work with hoisting equipment that it has been used regularly for phytoplankton for the last three years. A series of subsurface catches at fifteen depths from surface to one hundred meters has been obtained with it in thirty-two minutes.

No method of collecting plankton can be completely satisfactory for all purposes, or for all of the diverse components of a mixed population. In choosing the methods finally adopted as standard I recognized four desiderata: tolerable accuracy, sim-

plicity, speed of operation and low cost. For material appropriate to its uses the measured volume, silk filtration method has proved to be not only many times as accurate as the tow-net, but for diatoms it gives results well within the limits of error of sampling. The simplicity, speed and low cost of the method have all proved to be extremely valuable for most important reasons: *i.e.*, collecting could be done by many different kinds of people, it could be done under very difficult conditions, it could be done in many different places and it could be maintained with high degrees of continuity.

Aside from study necessary for identification of specimens, the method of examination of material has consisted mainly of the enumeration of individual colonies and cells in a selected fraction of a catch in a Sedgwick-Rafter counting cell. From this enumeration estimated numbers per liter have been calculated and the results tabulated and otherwise recorded for interpretation. Since cells and colonies of any species differ markedly in size and since this difference is even greater between representatives of different species and genera, it seems to be fairly obvious that such census taking does not reveal the amount of food for fishes and other animals available in a sample of sea-water, and that it gives no idea of differences in mass production in different waters sampled. However, it seems equally obvious that if large numbers of cells (even though small in size) are being produced there must be some support for production in the water sampled. Furthermore, the census records afford a basis for comparison of conditions of prominence of different species, and they avoid the inclusion of unrecognizable débris which must occur in strictly volumetric studies. The census-taking method of study of plankton material is onerous, time-consuming and otherwise disagreeable, but in my experience it seems to be far superior to other methods of investigation in plankton ecology, although volumetric and cultural studies may be made to yield valuable supplementary information.

Results of Investigations

In my opinion, one of the most important results of these ten years of work is the showing that a great deal of highly valuable scientific investigation of marine organisms can be done with simple equipment and at low cost.

In a particular locality seasonal distribution of microplankton organisms may differ widely from year to year, and the relative numbers of representatives of component species may differ widely from month to month and year to year.

In general, diatoms have been found much more abundant than dinoflagellates, but this numerical relationship is sometimes reversed for a considerable period. Furthermore, small dinoflagellates show heavier losses than diatoms at the practicable speed of filtration.

Maximum abundance of both diatoms and dinoflagellates tends to occur in spring but it may occur at another season in certain years in particular localities.

Abundance is usually very low in May, August and December, the condition having fewer exceptions for August than for the other two months.

Very low abundance of diatoms and dinoflagellates or relatively high abundance of diatoms may occur in any month in Southern California, but very high abundance of dinoflagellates has been observed only in or near the summer season.

Certain species of diatoms have been found in all regions of the East Pacific from Peru to Alaska, but others seem to be confined to narrower limits of latitude.

While largest catches of diatoms have been obtained from rather high latitudes, some almost as large have been obtained along the California coast, and in all regions the localities of high abundance are near localities of low abundance. Furthermore, collections from higher latitudes have not yet had continuity sufficient to show that the annual total of production is greater than it is in low latitudes.

In the summer season certain species of diatoms have been found only at depths below twenty meters, while other species have been found only at depths above that level.

In the summer season (at least) the greatest abundance of diatoms seems to occur more frequently at depths from twenty to thirty-five meters below the surface than at levels above or below those limits.

Under certain conditions the abundance of diatoms tends to show negative correlation with the abundance of sunlight.

As yet no large catches have ever been obtained as far as one hundred miles from shore.

Nearly all species of diatoms recorded in these studies seem to be able to tolerate a wide range of temperature conditions. Apparently, most of them have similar tolerance for the normal extremes of salinity and a number of other physical and chemical conditions.

In the main the more spinose and attenuate specimens of diatoms seem to occur at lower levels where temperatures are relatively low and viscosity relatively high, thus failing to support the postulate of some investigators that tenuosity is an adaptive response to diminishing viscosity. I incline to think

it an adaptive response to feeble light, the attenuate form affording best conditions for absorption and utilization of such light.

Comparisons of pier series with those made offshore by boat indicate that inshore stations are fairly representative in showing seasonal trends of surface distribution of diatoms and dinoflagellates in a particular region.

Comparisons of surface series of collections with those taken from depths down to one hundred meters indicate that abundance at the surface may be widely different from that at several or all other levels at a particular time, although, in general, those localities more productive at the surface seem to be more productive in total.

It seems certain that a frequency of collecting of once in twenty-four hours is not high enough to yield a dependable basis for solving some localized problems of the microplankton. For some of these a frequency as high as six-hour intervals may be necessary.

Less than twenty species of diatoms included in five genera have been prominent in the institution records, although the total number of species recorded is considerably more than one hundred.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE NEW VOLUME OF SUMMARIZED PROCEEDINGS

THE Summarized Proceedings of the American Association for the Advancement of Science for the period from June, 1925, to June, 1929, was published October 15. It is four years since the preceding volume appeared, which was for the period from 1921 to 1925. While the new book contains much information about the association and its activities in the period reported, yet the part that will be most frequently used by most readers will probably be the Directory of Fellows and Other Members, which occupies 988 of the 1,192 pages.

This membership list is now the most up-to-date and the most nearly complete address list of American science workers and others interested in the advancement of science. It gives, in a single alphabet, the name and address of every person who has been enrolled in the American Association at any time between June, 1925, and June, 1929. About 21,000 names are included. Names of fellows are each preceded by an asterisk and names of endowment members are printed in large and small capital letters. Higher university degrees (M.A., Ph.D., etc.) are shown, together with the university that conferred each degree and the year it was conferred. Each entry includes the membership formula, which indicates one or more of the following association records: (1) year of election to membership; (2) year of election to fellowship, and year of election to (3) life membership or (4) sustaining membership. For the names of those who have resigned or have died since June, 1925, the formula shows also the year of resignation or the year of death in each instance. Finally, the formula for each member shows the section or sections of the association in which the member is most interested. This part of the book will be almost indispensable to many men and women of science and to others as well. The publication represents an important service performed by the association in the interest of intercourse and cooperation among American scientists and between them and the public.

The Proceedings part of this volume includes general records, such as the constitution and by-laws, the list of officially associated organizations, the complete roll of the presidents of the association, the roll of vice-presidents, secretaries and treasurers for the period 1925–29 and resolutions on general affairs adopted since June, 1925. It also includes list of officers and committees for each year reported and for each meeting in the period, and references to SCIENCE for association announcements, reports, etc., and for presidential, vice-presidential and other addresses given at the meetings and published in the official journal. With the Summarized Proceedings and the corresponding volumes of SCIENCE one has the proceedings of the association from June, 1925, to June, 1929.

An interesting graph is given, showing the annual rate of increase in association membership for the period from 1920 to 1928. On September 30, 1920, the total enrolment was 11,442 and this had increased to 18,462 by September 30, 1929.

The new volume may be secured from the permanent secretary's office, in the Smithsonian Institution Building, Washington, D. C., at a price of $3 to members of the association, or $4 to others. For cloth-bound copies, as long as the limited supply lasts, the price is $4 to members, $5 to others.

BURTON E. LIVINGSTON,
Permanent Secretary

HOTELS FOR THE DES MOINES MEETING

THE local committee for the approaching Des Moines meeting of the American Association and associated societies has furnished the following list of

Des Moines hotels, with the accompanying information. All prices given are for the least expensive rooms; *i.e.*, each price is to be read as if followed by the words "and upwards."

The session rooms for the Des Moines meetings are to be mainly in hotels, in the business district of the city. The many meeting places will be exceptionally near together and convenient for those who wish to go from one session to another, in order to hear papers presented before different organizations in the same half day. Hotel headquarters have been assigned to the various societies with the aim of having a society's sessions as convenient to its hotel headquarters as possible. The following list shows for each hotel the science groups that will use that hotel as headquarters:

Name and address of hotel	No. of rooms	Prices of rooms, per day, for each person			
		With bath		Without bath	
		Single	Double	Single	Double
Fort Des Moines, Walnut St. at 10th	400	$3.00	$2.00	.....	.....
Hotel Savery, 4th and Locust Sts.	350	3.00	2.00	.....	.....
Chamberlain Hotel, 7th and Locust Sts.	225	2.00	.....	$1.75	.....
Brown Hotel, 4th St. and Keosauqua Way	280	2.00	.....	1.50	.....
Franklin Hotel, 5th and Locust Sts.	120	2.00	1.50	.....	.....
Randolph Hotel, 4th St. and Court Ave.	150	2.00	.....	1.50*	.....
Victoria Hotel, 6th St. and Keosauqua Way	200	1.50	.....	1.00	.....
Irwin Hotel, 6th and Cherry Sts.	95	1.75	1.25	.....	.....
Elliott Hotel, 215 4th St.	130	1.75	.....	1.25	.....
Rogers Hotel, 6th and Mulberry Sts.	75	1.75	.....	1.25	.....
Foster Hotel, 8th and Walnut Sts.	50	1.50	.....	1.00	.....
Wellington Hotel, 5th St. and Grand Ave.	200	2.00	.....	1.50	.....

* With private toilet and running water.

Fort Des Moines Hotel, general headquarters for the American Association; also headquarters for mathematics, physics, chemistry, astronomy, anthropology, psychology, social and economic sciences, linguistics, engineering and education.

Hotel Savery, headquarters for zoology and medical science.

Chamberlain Hotel, headquarters for botany and the groups that are related to both zoology and botany.

Brown Hotel, headquarters for geology and geography.

Randolph Hotel, headquarters for agriculture.

Every one who plans to attend the Des Moines meeting should make hotel reservation at once or as soon as possible, writing directly to the management of the hotel selected and giving information as to the kind of room desired, naming the price to be paid and the time of arrival. It is also suggested that the letter state the highest price that will be paid without further consultation, in case all rooms having the price asked for may have been assigned before the reservation request is received. While there will probably be no lack of hotel accommodations at Des Moines, of course the lower-priced rooms are apt to be reserved first and those who defer making their reservations may not be able to secure just the sort of room desired. Those who make early reservations and subsequently alter their plans so as to make it desirable to release their reservations should inform the hotel management promptly.

Those whose societies do not open their sessions till Monday of convocation week (December 30) will find it very advantageous to arrive on Friday or Saturday and attend some of the association's general sessions and the sessions of other organizations held on those days. Sunday will offer exceptional opportunities for meeting other scientific workers, renewing old friendships and forming new ones. These great annual meetings of all kinds of science workers furnish the best of opportunities for personal contacts and for becoming acquainted with the progress of scientific work outside of one's own special field. And the recent trend of basic scientific thought on all lines makes it almost imperative that each investigator and each teacher should follow, as well as possible, the progress that is being made in other fields than his own. Many non-technical but reliable and inspiring lectures are being planned for the Des Moines meeting.

Other notes about the Des Moines meeting will appear from time to time in these pages and the regular Preliminary Announcement will make up most of the issue of SCIENCE for November 29. A note concerning Section F (Zoological Sciences) appeared in the issue for August 23, page 186; notes on Sections E (Geology and Geography) and I (Psychology) appeared in the October 25 issue, page 398.

BURTON E. LIVINGSTON,
Permanent Secretary

SCIENTIFIC EVENTS

INTERNATIONAL MAP OF THE ROMAN EMPIRE

THE *Geographical Journal* reports that at the International Geographical Congress at Cambridge last year the proposal, made in a paper read by Mr. O. G. S. Crawford, was adopted that a map should be published of the Roman Empire, based on the International 1/M map of the world. A special commission was appointed, with Brigadier Jack, director-general of the Ordnance Survey, as president, and Mr. O. G. S. Crawford as secretary. This commission held its first meeting in Florence on April 30 and May 1 this year. Representatives of Italy, Spain and Great Britain were present and the general character of the map was decided upon. A report of the conclusions reached has just been published. The first edition of the Ordnance Survey Map of Roman Britain was adopted as a general model. The area to be covered was fixed as that of the Roman Empire at the time of its greatest extent, the time ranging from the first appearance of the Romans in each region down to the fall of the Western Empire. In compiling the map the sheet of the 1/M map is to form the unit in each case, and the commission hopes to arrange for the printing and publication of each sheet by the government responsible for the corresponding 1/M sheet. A list of the 1/M sheets which will make up the map, with the name of the country whose government is responsible for their publication, is given in the report, as well as an index map.

The commission recognizes that many difficulties will arise in selecting the features to be shown on the map, but points out that it is of first importance to keep the map as clear and simple as possible. Further, the aim of the map is historical and not archeological—to show the distribution and character of population, the names of towns and natural features and the economic and social conditions of the period. Only Roman remains will be shown, and of cities only those inhabited during the Roman period, as defined above, or during some portion of it. The inclusion or omission of any site, however, will have to be decided on individual merits and not by any hard-and-fast rules. In addition to the names of inhabited sites, the commission states that wherever possible the names of topographical features should also be shown. The ancient name will be engraved in characters based on those used on Trajan's column, and the modern name in italics beneath.

The commission hopes to have several sheets published before the next meeting of the International Geographical Union at Paris in 1931. Sheet North K 33, on which Rome appears, is already in preparation, and will be printed with other Italian sheets by General Vacchelli, director of the Istituto Geografico Militare at Florence, on behalf of the Italian government.

AEROLOGICAL RESULTS OF THE GREENLAND EXPEDITIONS OF THE UNIVERSITY OF MICHIGAN

THE aerological observatory of the University of Michigan, located at Mount Evans in southwest Greenland (Lat. 66° 55′ N. Long. 50° 50′ W.), was closed on the twenty-ninth of July, 1929, after being in continuous operation for a period of two years. The several buildings and nearly all the meteorological and wireless installation have been left intact with a view to a possible reopening later. The winter staff of three men bringing the observational data for the last thirteen months reached Copenhagen on August 19, and the aerological and meteorological data for the entire two years are now at Ann Arbor being reduced for early publication.

To the records from Mount Evans, which include one or more pilot balloon ascents for each clear day, are to be added ninety-four ascents which were carried out during the summer of 1926 at the provisional station of that year on the Maligiakfjord located about fifty kilometers east of Holstensborg and about midway between Mount Evans and the coast. The balloon runs carried out at Mount Evans during the first eleven months numbered 337 and these were followed to an average altitude of about 7,000 meters. For the last thirteen months they numbered 439, making 776 in all. Two exceptional runs were followed to altitudes of 27,000 and 29,000 meters, respectively.

The aerological work of 1926 was in charge of S. P. Fergusson, that at Mount Evans between July 21, 1927, and May 28, 1928, in charge of Clarence R. Kallquist (each man on leave at the time from the U. S. Weather Bureau), that from May 28 to July 10, 1928, in charge of William S. Carlson, and that from July 10, 1928, to July 21, 1929, in charge of Leonard R. Schneider.

S. P. Fergusson, who has acted throughout in an advisory capacity, has been made editor of the aerological and meteorological data and is now on leave directing the work at Ann Arbor. Dr. C. F. Marvin, chief of the U. S. Weather Bureau, has from the beginning cooperated in the loan of meteorological equipment and has now generously granted to Mr. Fergusson the leave to undertake this work.

A comparative study of weather records has been undertaken on the basis of a secondary station established and maintained by the expedition since the summer of 1927 at Holstensborg in the same latitude

but on the coast. The records made there will be compared with those taken at Mount Evans and with others taken in a tent station upon the ice-cap about thirty miles east of Mount Evans during a period of fifty days in the months of January, February and March, 1928. This comparative study, which is of great importance in view of the peculiarly local character of Greenland weather observations, is in charge of Dr. J. E. Church, Jr., a member of two of the expeditions and the companion of Helge Bangsted in the winter ice-cap expedition of 1928. The first volume ("Aerology") will include the tabulated aerological observations with accompanying graphs.

William Herbert Hobbs

Ann Arbor, Michigan

CHEMICAL EDUCATION AT THE JOHNS HOPKINS UNIVERSITY

As has been recorded here the Francis P. Garvan Chair of Chemical Education was dedicated at the Johns Hopkins University on October 11. An article in *Industrial and Engineering Chemistry* reports that the dedication took place with due ceremony in the main auditorium of Remsen Hall at Homewood, the dedicatory address being given by Dr. Joseph S. Ames, president of the university. In response an address prepared by Mr. Garvan was read. Dr. John J. Abel and Dr. Irving Langmuir spoke on "The Education of the Superior Student," and in the afternoon a conference on "The Selection and Training of the Superior Student" was held, attended by the donors of fellowships and by distinguished guest chemists and educators, as well as officials and chemistry faculty of the university.

In the evening Dr. C. E. K. Mees, director of research of the Eastman Kodak Company, gave a popular illustrated lecture on "The Formation of the Photographic Image." This was the first of a series of public lectures to be given at the Johns Hopkins University during the academic year under the newly established A. R. L. Dohme lectureship. The lecturers announced in addition to Dr. Mees include the following: Max Bodenstein, Frederick George Donnan, R. A. Millikan, F. O. Clements, F. G. Cottrell, C. M. A. Stine, W. B. Brockway, John J. Abel, F. C. Frary and N. A. Shepard.

The new plan for the selection and training of superior students in chemistry, recently formulated at the Johns Hopkins University, was initiated simultaneously with the dedication. In all, nineteen fellowships have been established on this plan, each providing $1,000 annually for four years, continuance from year to year depending on a satisfactory record. Nine holders of fellowships have already enrolled. The donors and the states from which the students will come are as follows:

Eli Lilly Co., Indiana.
Firestone Tire and Rubber Co., Ohio.
J. T. Baker Chemical Co., New Jersey.
H. A. B. Dunning, Maryland.
Bill Raskob Foundation, Delaware.
Brown Co., Maine and New Hampshire.
Kewaunee Mfg. Co., Wisconsin.
General Motors Corp., Michigan.
Carbide and Carbon Chemicals Corp., West Virginia.
William S. Speed, Kentucky.
Fleischmann Co., Washington.
Francis P. Garvan, New York. One for New York State, one in honor of his mother, Mary Carroll Garvan, and one in honor of his father, Patrick Garvan, of Connecticut.
John Wiley & Sons, Pennsylvania.
U. S. Industrial Alcohol Co., Louisiana.
Hormel Foundation, Minnesota.
E. I. du Pont de Nemours & Co., Inc., Virginia.

FORESTRY EDUCATION

Plans for an investigation of the problems of forest education are being sponsored by the Society of American Foresters, with Dr. Henry S. Graves, dean of the Yale School of Forestry, as director. The inquiry has been made possible by a grant of $30,000 by the Carnegie Corporation of New York.

The responsibility for the conduct of the inquiry has been delegated to Dean Graves, *director;* C. H. Guise, assistant professor of forest management at Cornell University, *assistant director;* Dr. George A. Works, president of the Connecticut Agricultural College, adviser in the field of education, and Dr. E. J. Kraus, professor of botany at the University of Chicago, adviser in the general field of science. The inquiry will first secure information about forestry as an occupation, about institutions now teaching forestry and about the success and shortcomings of the present systems of forest education. The information will then be analyzed and a solution to educational problems will be attempted. Information will be sought as to the number of trained men who may be absorbed in each type of occupation in forestry, the opportunities for advancement, compensation, living conditions and opportunities for creative work and community service. A comparative study of forest education in foreign countries will be made. A large amount of information has already been obtained from the National Academy of Sciences. Special attention will be given to the systems of forestry in Canada, Europe and the Orient.

The special committee of the Society of American Foresters, which will assist in the inquiry and which may be enlarged later, includes Robert Y. Stuart, chief forester, U. S. Forest Service, *chairman;* Irving W. Bailey, professor of plant anatomy, Harvard University; Earl H. Clapp, chief of the branch of re-

search, U. S. Forest Service; Livingston Farrand, president, Cornell University; Henry S. Graves, dean, Yale School of Forestry; William B. Greeley, secretary and manager, West Coast Lumbermen's Association; Lewis R. Jones, professor of plant pathology, University of Wisconsin; Raymond E. Marsh, branch of research, U. S. Forest Service, and secretary of the Society of American Foresters (*ex-officio*); David T. Mason, consulting forester; Barrington Moore, editor of *Ecology;* Charles Lathrop Pack, president, American Tree Association; W. A. Pickering, Pickering Lumber Company; John F. Preston, Hammermill Paper Company; Paul Redington, chief of the U. S. Biological Survey and president of the Society of American Foresters (*ex-officio*); R. B. Robertson, president, Champion Fiber Company; Ward Shepard, branch of public relations, U. S. Forest Service, and E. O. Siecke, state forester of Texas.

SCIENTIFIC NOTES AND NEWS

THE one hundredth anniversary of the birth of Dr. S. Weir Mitchell will be commemorated on November 6 in Mitchell Hall at the College of Physicians of Philadelphia, by an address by Dr. Frederick Tilney, of New York, on "The Structural Basis of Behaviorism."

A PORTRAIT of the late Arthur Loevenhart, former head of the department of pharmacology of the medical school of the University of Wisconsin, has been hung in the auditorium of the Memorial Institute of the Wisconsin General Hospital. The portrait is an expression of appreciation for the service that Dr. Loevenhart has rendered to the university and to the nation. The donors are colleagues, friends and students. The portrait is by R. S. Stebbins, of the art department of the university.

A BAS-RELIEF in memory of Dr. John Howland was unveiled on October 17, in the amphitheater of the Harriet Lane Home for Invalid Children of Johns Hopkins Hospital, Baltimore. Dr. Howland, before his death in London in 1926, was director of the home for fourteen years and head of the department of pediatrics at the Johns Hopkins University School of Medicine. Dr. Joseph S. Ames, president of the university; Dr. William S. Thayer, past president of the American Medical Association; Mr. Charles H. Baetjer, president of the board of managers of the Harriet Lane Home, and Dr. Edward A. Park, who succeeded Dr. Howland, were the speakers. The bas-relief of stained marble has a likeness of Dr. Howland in the center, and that of a child on each side.

AMONG paintings presented to Columbia University on the occasion of the celebration of its one hundred and seventy-fifth anniversary are portraits of Dr. Henry Fairfield Osborn, research professor of zoology (artist, Kenneth Frazier); Dr. Michael I. Pupin, class of 1883, professor of electromechanics (artist, Mrs. Emmett Rand), and Dr. Edmund B. Wilson, DaCosta emeritus professor of zoology in residence (artist, William Steene).

DR. SIMON FLEXNER, director of the Rockefeller Institute for Medical Research, will deliver the anniversary discourse at the eighty-third annual meeting of the New York Academy of Medicine on November 7 at 8:30 P. M. His subject will be "The Infinitely Small in Biology and Medicine."

THE gold medal of the Mining and Metallurgical Society of America has been awarded to Cornelius F. Kelly, president of the Anaconda Copper Mining Company, for "distinguished services in expanding and stabilizing the industry."

THE John Scott medal has been awarded by the city of Philadelphia to C. P. Dubbs "for the discovery and development of a process for economically producing gasoline on a large scale."

QUEENS UNIVERSITY recently conferred the honorary degree of doctor of laws on Charles Le Geyt Fortescue, chief consulting transmission engineer for the Westinghouse Electric and Manufacturing Company.

DR. REGINALD A. FESSENDEN, consulting engineer and inventor, has been chosen to receive the *Scientific American* gold medal for promoting safety at sea awarded through the American Museum of Safety. The medal will be presented to Dr. Fessenden by Arthur Williams, president of the American Museum of Safety, at a luncheon at the Union League Club on November 7. Dr. Fessenden's inventions include the fathometer, a device for obtaining quick and accurate soundings for vessels, direction finders, electrical and radio devices and compasses.

DR. LOUISE PEARCE, of the Rockefeller Institute for Medical Research, New York, has been elected an honorary member of the British Medical Society for the Study of Venereal Diseases.

DR. KARL BURCKHARDT, the geologist, of Mexico; Dr. David Hilbert, Dr. I. Hadamard and Dr. Salvatore Poncheile, professors of mathematics at Göttingen, Paris and Boulogne, respectively, have been elected foreign members of the Swiss Scientific Association.

THE council of the British Institution of Civil Engineers has awarded the Indian premium for the ses-

sion 1928–29 to Mr. H. N. Colam (Simla) and a Webb prize to Mr. C. Gribble (London).

Promotions to the rank of rear-admiral have been made in the Navy of Captain Charles Edward Riggs, at present chief of the bureau of medicine and surgery, and of Captain Norman Jerome Blackwood, at present in command of the Naval Hospital at Puget Sound, Washington.

Dr. J. Hubert von Pourtales, clinical pathologist at the New York Foundling Hospital, has been appointed to the newly created office of assistant director of laboratories at the New York Neurological Hospital, Medical Center, New York City.

Dr. Lyman F. Kebler has resigned from the Office of Collaborative Investigations of the Food, Drug and Insecticide Administration, U. S. Department of Agriculture, to become medical director for commercial companies.

Professor J. J. Davis, Purdue University; Professor E. O. Essig, University of California; Dr. W. H. Larrimer, U. S. Department of Agriculture; Dr. L. S. McLaine, Canadian Department of Agriculture; Dr. F. E. Lutz, the American Museum of Natural History; Dr. C. L. Metcalf, University of Illinois, and Professor T. H. Parks, the Ohio State University, are members of a committee that is making a study of the best methods by which the progress made in entomological research in the United States in the past one hundred years can be demonstrated at the Chicago World's Fair Centennial in 1933. Dr. W. P. Flint, economic entomologist in the state natural history division of the University of Illinois, is chairman of this committee.

Three-year reappointments on the Forest Research Council have been made as follows: Professor J. W. Toumey, Yale Forest School; Mr. W. R. Brown, The Brown Company, Berlin, N. H.; Mr. R. S. Kellogg, secretary, News Print Service Bureau, New York City, and D. W. L. Slate, Jr., director of the Connecticut Agricultural Experiment Station, New Haven, Conn. The council serves in an advisory capacity in developing the research program of the Northeastern Forest Experiment Station, with headquarters at Amherst, Mass. This station is engaged in working out the best methods of forest protection, reforestation, timber growing and other forestry practices in the New England states and New York.

Professor Howard E. Simpson, of the department of geology of the University of North Dakota and state water geologist, served with the Canadian Geological Survey during a portion of the past summer in making a survey of the ground-water resources of Regina, Saskatchewan, with a view to improving the public water supply of that city.

Dr. H. McE. Knower is spending the winter as a guest of the Wistar Institute. He is completing drawings and writing up the results of investigations on the lymphatics and blood vessels of amphibian embryos.

Dr. Ray S. Bassler, of the U. S. National Museum, has returned from Prague, Czechoslovakia, where he has spent some time making casts of types of species of fossils described in Barrande's "Système Silurien du Centre de la Bohème."

Dr. John K. Small, head curator of the New York Botanical Garden, spent part of August and September in Florida and other gulf states, continuing his studies of the genus iris, certain palms and other southern plants. Dr. A. B. Stout, of the same institution, recently returned from Maine, where he has been investigating hybrid poplars and forestation.

Dr. William Beebe, director of the tropical research division of the New York Zoological Society, has returned to New York from his thirty-second expedition, known as the Bermuda Oceanographic Expedition, with 100,000 specimens of deep-sea fish. Dr. Beebe also brought a detailed description of marine life a mile beneath the surface of the water.

Dr. and Mrs. Kenyon L. Butterfield have sailed *en route* for India, where Dr. Butterfield will study agricultural and rural conditions. Dr. Butterfield, who was formerly president of the Massachusetts Agricultural College and of the Michigan State College, has been appointed counselor on rural work by the International Missionary Council, of which Dr. John R. Mott is chairman. In India he will study the needs of rural communities, help to teach better methods of farming and make recommendations to the government for raising the standard of living. After a year there he will go to China to repeat his work. Dr. Butterfield returned recently from South Africa where, as visiting professor of the Carnegie Foundation, he was engaged in similar activities.

Dr. E. K. Marshall, professor of physiology in the Johns Hopkins Medical School, will deliver the second Harvey Society Lecture at the New York Academy of Medicine on Saturday evening, November 2. His subject will be "The Minute Output of the Heart in Health and Disease."

A joint meeting of the Philosophical Society of Washington with the Geological Society of Washington was held on October 23, when Dr. Beno Gutenberg, professor of geophysics in the University of Frankfurt, delivered an address on "Some Hypotheses on the Development of the Earth's Crust."

Professor Karl Sudhoff, director emeritus of the institute of the history of medicine of the University

of Leipzig, gave an illustrated lecture on "Cos and Cnidos," on October 22, at the Rockefeller Institute for Medical Research, New York, under the auspices of the institute, the History of Science Society, the section of historical and cultural medicine of the New York Academy of Medicine and The Charaka Club.

A DINNER on October 31 marked the opening of the annual campaign of the New York City committee of the American Society for the Control of Cancer, and a meeting at the academy of medicine on November 8 will close the campaign. During the week, meetings will be held in churches, settlement houses and high schools. The dinner, at which Madame Curie was to be the guest of honor, was one of three public events at which she appeared during her visit to this country. The meeting at the New York Academy of Medicine will be addressed by Dr. Clarence C. Little, Dr. Matthias Nicoll, Jr., and Dr. Francis Carter Wood, who will present the Canti Cancer film showing the effect of radium on normal and cancerous tissues.

THE Chi Chapter of the Tri Beta Biological Fraternity will be installed at Drury College, Springfield, Mo., November 15, 1929. Dr. William M. Goldsmith, president of the fraternity, will make the principal address of the occasion.

THE Allegany School of Natural History at Quaker Bridge, New York, completed its third summer season of seven weeks during July and August. The school, in a forest in Allegany State Park, offers combination field and laboratory courses in several fields of biology and geology. Its enrolment last season comprised chiefly teachers, college students and university graduate students from ten states, including the District of Columbia.

THE Wistar Institute has been advised by Commissioner-General Harry E. Hull, of the U. S. Department of Labor, Bureau of Immigration, that it has been approved by the secretary of labor as an institution of learning for immigrant students, in accordance with the immigration act of 1924. Foreign investigators who wish to enter the institute as laboratory guests should communicate with the director and obtain the permission and information that will be necessary in making application to American consuls for necessary visas.

A NEW park of 500 acres and a lake of 225 acres have been acquired by New York State as the result of a gift of D. McRae Livingston, of New York City. The area is in Columbia County, forty miles southeast of Albany, near the Massachusetts line, and is in a mountainous region.

THE British Medical Research Council announces that they have received from Mrs. Odo Cross a sum of £40,000 as the endowment of a trust for the establishment of research fellowships for the study of tuberculosis, to be known as the "Dorothy Temple Cross Research Fellowship Fund." The amount in question is the total sum received by Mrs. Cross in respect of her daughter's estate, no part of which does she desire to retain for her own benefit.

DR. HENRY FAIRFIELD OSBORN, president of the American Museum of Natural History, has received a letter from Dr. William K. Gregory, of the expedition sent out under the auspices of Columbia University and the American Museum to study and photograph gorillas and obtain anatomical studies of them, together with similar studies of chimpanzees and other African primates. Dr. Gregory states that on August 20 Mr. H. C. Raven, the leader, secured a big male gorilla. Mr. Raven said after two "fake charges" the animal came straight at him and he shot it in the face. The party, which left New York in May, 1929, consists of Dr. J. H. McGregor and Dr. E. T. Engle, of Columbia University, and Mr. H. C. Raven and Dr. William K. Gregory, of the American Museum. In addition to the study of gorillas, special studies of the unshod feet of natives will also be made. Inasmuch as the party can collect but two specimens of gorillas, great care was exercised in the selection. This feature was complicated by the fact that they live in the thickest bush where one can seldom see more than an indefinite shadow. After the second gorilla is obtained, the work of photographing living gorillas will begin, but, Dr. Gregory continues, "the conditions are most difficult and only a fortunate chance can yield us any photos of value. The gorillas are masters in the art of concealment and of disappearance. The big males have a mean habit of charging the observer and they seem to realize that there is a fine of 5,000 francs for killing a gorilla without a permit. Nevertheless, McGregor got within speaking distance of a family party of them nearly a week ago and we are all hoping for similar opportunities soon."

Nature reports that at the eighth annual general meeting of fellows of the National Institute of Agricultural Botany at Cambridge on July 26, the chairman of the council, Dr. E. S. Beaven, reviewed in turn the principal activities of the institute in the past year. Two important branches of the work, the Official Seed Testing Station, and the Wart Disease of Potatoes Immunity Trials, are delegated to the institute by the Ministry of Agriculture, and these functions are supplemented by cognate investigations

into germination problems, potato virus diseases, and the yield and maturity of potato varieties. The potato Synonym Committee, of which Dr. Salaman is the chairman, has reported a substantial improvement in the nomenclature of potatoes; the council hopes to win the cooperation of seed men in extending this work to cereals. Dr. Beaven referred to the encouragement offered in the last century by the Royal Agricultural Society to plant-breeders and, after tracing the relationship between animal and plant breeding and the influence of Mendel's work, pointed out that field trials of the kind undertaken by the institute would be needed for many years. The difficulty of the task and the value of the results were illustrated by the series of barley trials completed in the past year. Two varieties raised by systematic methods of plant breeding were shown to be generally and significantly more profitable to farmers than any others, and records collected independently by the Official Seed Testing Station and the Essex County Farmers Union not only confirmed this conclusion but also showed that these two varieties are now grown more widely than any others. The study by competent critics of these and the similar results now being obtained at the institute should win for it the support of agriculturists.

UNIVERSITY AND EDUCATIONAL NOTES

The dedication of the new Markle Museum Engineering Building at Lafayette College will take place on December 6. During the week there will be a conference on mining engineering and a series of lectures by prominent engineers.

A gift of $100,000 to the building fund of Boston University has been made by Dr. William E. Chenery and Mrs. Chenery. Dr. Chenery is a nose and throat specialist of Boston and a lecturer at the medical school of the university, of which he is also a trustee.

Dr. L. V. Heilbrunn has become associate professor in the department of zoology at the University of Pennsylvania. Last year the courtesies of the department of biology at the Washington Square College of New York University were extended to him and he carried out there work on the effect of temperature on the viscosity of amoeba.

Earl W. Henderson, of the University of Missouri, has been appointed head of the department of poultry husbandry at the Iowa State College.

Professor P. H. H. Gray, a graduate of Queen's College, Oxford, has been appointed head of the department of bacteriology at Macdonald College (faculty of agriculture, McGill University) and has recently arrived to assume his duties. He goes to Macdonald from the Rothamsted Experimental Station, where he has been engaged in research work in soil microorganisms and general microbiology.

Dr. H. W. Davies, lecturer in physiology in the University of Leeds, has been appointed to the chair of physiology in the University of Sydney.

DISCUSSION

IS THERE AN AGE DEAD-LINE IN THE SCIENTIFIC AND ENGINEERING PROFESSIONS?

Recent articles in various periodicals have called attention to an age dead-line, not only in manual occupations, but also in sedentary positions. Among the causes to which this situation is attributed are physical condition, retirement pensions, decreased productivity, liability to injury, and group insurance, all of which are said to militate against the employment of men over forty.

The general subject of unemployment in the scientific and engineering professions has aroused considerable discussion recently, as evidenced by several notes in the scientific journals. It is, therefore, of timely interest to consider whether or not conclusions regarding an age dead-line drawn from mass data on employment as a whole can be accepted without question as applying to the scientific world, since in certain respects the technical man occupies a position apart.

The comparative newness of the technical professions and the remarkable expansion of industries involving science and engineering have resulted, in the past few years, in an unprecedented demand for scientists and engineers. This demand has been augmented by the fact that many manufacturers have come to realize that research and development work are an investment. Such executives now adopt a more patient and sympathetic attitude toward the technical man. Experience has shown them that just as industrial research has made many important contributions to theory, so does disinterested investigation often give findings of great commercial value. That is to say, any research whatever has a reasonable chance of being profitable.

At this point it should be noted that the organization and personnel of the scientific and engineering

professions are such that comprehensive data on employment are not readily available. Any general conclusions must, therefore, be an integration of the experience of those having contact with comparatively large numbers of technical men.

In view of these considerations we feel that the conditions observed at Mellon Institute will be of general interest. Because of the size of our research staff—about 175 men, chiefly chemists—a large file of applicants is constantly maintained in order to provide candidates for future vacancies. Our records show that comparatively few older men have made application, and that, with few exceptions, these cases are men now employed who, for various reasons, are desirous of changing their positions. In other words, we do not feel that the age dead-line has yet become a vital factor in technical unemployment.

An analysis of our applicant file into age groups has given the following data:

Age range	Percentage of total number of applicants
20–25	30
26–30	33
31–35	15
36–40	13
41–45	3
46–50	4
Above 50	2

The significance of our records is qualified by the fact that our fellowship candidates are to some extent limited to younger scientists desirous of pursuing research careers, but, at the same time, it must be realized that our research staff requires not only recent graduates as fellowship assistants, but also older men, with well-established reputations, as industrial fellows and senior industrial fellows. In addition, because we have often been of assistance in placing men in plant and executive positions, we receive many applications from men not interested in research institution posts.

The older men who apply to us for positions may be classified in the five groups which are briefly defined as follows. (1) Frequently specialists in their respective fields, although already employed, feel that the institute offers particular advantages for the careers which they contemplate; while our files contain the names of many such men, we often think it advisable to make a special search for a more suitable man for a given position. (2) Teachers in the neighborhood of forty frequently conclude that they are more suited for industrial work or that they need larger salaries to support their families, and accordingly request our aid in securing a more satisfactory type of work. (3) Similarly, many older men in the industries become oppressed by the thought that they are in a "rut" and decide to seek positions offering wider opportunities. (4) Sometimes able men are thrown out of work by the combination of two companies with separate technical staffs or by the curtailment of the technical staff in one organization. (5) Finally, the last class, which is fortunately unusual, comprises men who have not made good in teaching or industrial work and who are casting about for new positions; such men are often peripatetic in positional habits.

A pitiful case, now rarely seen, was that of the scientist or technical man who was swept off his feet and much bewildered for a time because of the sudden growth of the specialties and his apparent loss of professional status. Many chemists, for example, awoke to find every division of the science of chemistry preempted and staked off. What had formerly been their sole care had apparently been taken over by specialists—physical chemists, metallurgists, ceramists, chemical engineers, organic chemists, biochemists and others. They not only wondered what finally would be left for them to do, but what the exact status of their activities really was. They failed to realize fully the fact that it was but the natural result of modern advance in chemical science and a part of an orderly, well-organized and highly developed research system—industrial as well as pure-science research methodology.

Our impressions of the conditions obtaining to-day are borne out roughly by the situation in 1921, during the general business depression. While there was then much unemployment among technical men, we do not believe that the older men were discriminated against.

If, as we are inclined to believe, the dead-line has not yet become an important factor in the technical professions, there could be no more opportune time to consider what measures can be taken to combat it when necessary, to insure a dignified and comfortable future for the older men. At Mellon Institute we have been approached by retired chemists and engineers with the request that they be given laboratory facilities to enable them to devote their remaining productive years to research in pure science. This experience suggests a policy which may be of importance in the future, namely, the creation of departments in large industrial laboratories and research institutions in which older men may be able to bring to bear upon scientific problems the experience gained in long years of service to their professions. In institutional research laboratories, in particular, such older scientists, being respected, would be valuable in aiding younger men and in promoting desirable scientific attitude and *esprit de corps*.

Such an addition to the ranks of workers in pure science would not be disproportionate. The men engaged in pure research are already far too few, and the superior and more immediate rewards in applied science are constantly reducing the numbers of those who are on the quest for new facts without regard to their economic application. Mr. Hoover recently estimated the number of American workers in pure science to be three thousand, as against thirty thousand in applied science. And yet these thirty thousand are constantly deriving much valuable help from the basic work of the three thousand.

To conclude, our experience would indicate that at the present time an older man, duly qualified with respect to technical ability and personal attributes, is not handicapped by his age, in spite of the progress made in technical education in recent years, in addition to the other considerations which have been cited as causative of an age dead-line. We offer this view, not with the feeling that it represents the last word on this important subject, but rather with the object of encouraging a profitable discussion based upon experience.

William A. Hamor
Lawrence W. Bass

Mellon Institute of Industrial Research

DESCRIPTION OF AN ALLIGATOR NEST

While I was in the marsh region of southern Louisiana, some ten miles south of Morgan City, my attention was directed to a nest of the American alligator (*Alligator mississippiensis*) by Mr. Billy Burke, a native of that region. Mr. Burke came upon the nest while hunting frogs along a narrow canal which extended back into the marsh some three miles from the main bayou. A well-worn runway or "run" led from the canal bank to the nest itself, which was about twenty feet back into the marsh.

On July 25, 1925, a party, including the author, visited the nest. Besides the "run" from the canal to the nest, several other "runs" were discovered which led off from the nest into the surrounding marsh. The vegetation immediately surrounding the nest had been either trampled down by the alligator or else removed for the building of the nest. The "runs" were clearly defined and were about a foot and a half wide.

The nest was made of bits of damp, rotting "paille-fine" grass (*Spartina patens juncea*) and "roseaux" (*Phragmites communis*) which had evidently been bitten off by the female alligator. The nest measured four feet in diameter by two feet high. In shape, it was rather square with rounded corners and a flat top. The whole nest was strikingly similar to a muskrat house except that it had a flat rather than a conical top. Also no mud was used in the construction of the nest.

In the center, about six inches below the surface of the top, was the nest proper. In it, covered with the warm, rotting vegetation, were twenty-four white, hard-shelled eggs, cylindrical in shape and rounded at the ends.

The following variations in weights and measurements were found:

Weights—	
Variation	59.96 gms to 69.41 gms
Average	63.74 gms
Measurements—	
Variations	70.4 mm by 37.7 mm to 75.5 mm by 38.6 mm
Average	72.3 mm by 38.07 mm

The nest had been known by Mr. Burke for about three weeks before our visit, or since about June 14. How long the nest had been there before this time is not known. It may be possible that the nest was built some time previous to the egg-laying in order to give the nest material a chance to heat up for the incubation process.

The female alligator did not appear while we were examining the nest, although according to local accounts the female alligator is constantly on watch to protect her nest from all marauders.

Arthur Svihla

University of Michigan

A STARFISH ATTEMPTS TO INGEST A MINNOW

The starfish is known completely to ingest small mollusks, later extruding their shells. The most striking of its achievements is to attach firmly, by the tube feet of its rays, to an oyster or clam and exert a slow, steady pull until the mollusk is opened. Then the starfish protrudes its evertible cardiac stomach and digests the soft parts of the mollusks *in situ*. Protrusion of the stomach is facilitated by a pronounced humping of the disk of the starfish.

While at the Marine Biological Laboratory, Woods Hole, Massachusetts, on the morning of July 5, 1929, the writer observed that a starfish (*Asterias forbesii*), with rays averaging eight centimeters in length, had attached to the glass side of an aquarium, and by its tube feet firmly held between two adjacent rays a full-grown Fundulus ten centimeters in length. The head of the fish was partly ingested, but the cardiac stomach protruded about two centimenters along the body. The starfish had a pronounced hump, roughly estimated at one and a half centimeters.

In the preliminary handling of the animals incident to preservation, the cardiac stomach was partly with-

drawn, but the head of the fish remains firmly held in the oral opening of the starfish.

It is quite unlikely that the starfish captured a living Fundulus, but the animal had probably died during the night, as all dead fish were removed from the tank on the day previous.

F. E. CHIDESTER

WEST VIRGINIA UNIVERSITY

PEOPLE ATTACKED BY AN OWL

ON a residence street in Morgantown, West Virginia, during the early summer of the present year, several people were attacked by a small, savage owl. At least three people, personally known to the writer, were thus attacked, the owl swooping down and striking them with its claws. One person, a man with a scant supply of hair, had the top of his head scratched; another person, a woman, had her face badly scratched and, but for her glasses, might have had her eyes injured.

After thus attacking people for some days the owl was shot, but the writer did not hear of the attacks until some weeks later, and so could not personally identify the bird. From descriptions, however, it would seem that it was a screech-owl, the commonest species in this region.

It would be interesting to know if such attacks by owls have been noted by others.

ALBERT M. REESE

WEST VIRGINIA UNIVERSITY

SCIENTIFIC BOOKS

The Autonomic Nervous System. By ALBERT KUNTZ. Lea and Febiger, Philadelphia, 1929, 576 pp., 70 figs.

DURING the past few years increasing appreciation of the importance of the autonomic nervous system in health and disease has stimulated investigation in the pathological and clinical aspects of the subject. This, coupled with numerous recent attempts to determine details of the finer structure of components of the system as well as the exact anatomical and physiological relationships of its neurons, has swelled an already voluminous literature.

In the present work the author has tried to do justice to this relatively enormous literature as far as possible within the limits of a volume of this size. The degree in which he has succeeded raises the book quite out of the ordinary. Comprehensiveness, conciseness and judicial evaluation, in the measure here attained, make a combination deserving hearty commendation.

It is of more than passing interest that the author has chosen to employ the Langley terminology for this division of the nervous system and for the classification of its parts. This, to the reviewer, is a happy beginning for the highly desirable resolution of the confusion of tongues now existing. There is no good reason why "sympathetic" should be used by one group to designate the entire autonomic system and by another group to name one of its subdivisions. Nor is there reason why "autonomic" should be used in a correspondingly equivocal manner. Here, as elsewhere, usage must in the end prevail over priority or logic. In a brief introduction the author traces the history of the several terminologies which have been employed.

The first five chapters of the twenty which comprise the book are devoted to general subjects including the morphology of the autonomic system and its component neurones, central autonomic centers and conduction pathways, the general physiology and the development of the system. Ten chapters are next given to careful consideration of the autonomic innervation and control of systems and of individual organs. These include the heart, blood vessels, respiratory system, digestive tube, biliary system, glands, urinary and sex organs, the eye and skeletal muscle. This part of the book is enriched with numerous excellent illustrations.

Particularly welcome, because of the newness of their appeal, are such chapters as those on "central autonomic centers and conduction pathways" and the "autonomic innervation of skeletal muscle." In these are gathered much information otherwise to be found only in widely scattered individual contributions. The latter chapter, although on a subject somewhat controversial at the present time, can not be said to be unduly Kuntzian.

The remaining five chapters treat of pathological and clinical aspects of the subject. These will be of interest to physicians and surgeons who desire to learn the rationale of many procedures now being introduced into the practice of medicine. The appeal of these chapters is indicated by their titles which include the pathology and the surgery of the system, visceral sensitivity and referred pain, vagotonia and sympatheticotonia and the autonomic system in diseases.

Not the least valuable feature of the book is the bibliography which covers sixty pages and is arranged by chapters.

WAYNE J. ATWELL

UNIVERSITY OF BUFFALO

SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN IDEAL MOUNTING MEDIUM FOR MYCOLOGISTS

DURING the past three years the writer has used Amann's mounting medium with unusually satisfactory results. Although it is in rather general use abroad, this medium does not appear to be widely employed in this country, despite its many advantages over eosine-glycerine. In the study of dried material there is little delay, for this medium almost immediately restores the turgor of the specimens, while with fresh material there is no plasmolysis, especially in the higher fungi, and at the same time the medium serves as a killing agent. In addition to its application to mycology, the solution has been successfully used by Dr. Edgar Anderson, of this institution, in the course of his study of the pollen grains of *Iris*.

The formula, after Sartory,[1] is as follows:

Carbolic acid crystals	20 grams
Lactic acid, syrup	20 "
Glycerine	40 "
Distilled water	20 "

For greater rapidity in mixing the above materials, they may be heated over a low flame. When the solution has cooled, it may be used as made up, or should a dye be desirable, as is often the case with hyaline specimens, then .5 per cent. of cotton blue should be added. Frequently this concentration of dye is excessive, in which case the color may be made more dilute by the addition of varying proportions of the original medium.

Permanent preparations may be made by allowing the mounted specimen to stand a week in a desiccator to allow the water to evaporate, otherwise the ringing cement (preferably King's amber cement) will tend to run under the cover-glass. The lactophenol medium can also be used in connection with Diehl's[2] method of making permanent preparations if the same precautions (desiccation) are followed.

DAVID H. LINDER

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NOTE ON PREPARATION OF COLLODION BAGS

FOR those interested in the use of collodion bags for dialysis, classroom experiments in physiology, etc., where uniformity and ease of preparation are important, I should like to call attention to two papers doubtlessly overlooked at this late date: Harris, N. M., *Centralb. f. Bak. und Par.*, I, 32, 74, 1902, and Gorsline, C. S., SCIENCE, p. 375, March 7, 1902.

Both authors describe the formation of a collodion bag on the outside of large gelatine capsules held by heated glass tubing thrust into one end, over which the collodion may form a narrow neck to the bag of perfect uniformity and free from flaws to any desired thickness. Warm water allowed to flow into the capsule after drying of the outer collodion coating dissolves the interior gelatine wall, leaving the perfect collodion bag. The glass tubing may be left in place or removed, as desired. This apparatus was originally intended to contain bacterial culture material for insertion into the peritoneum, allowing dialyzable bacterial products to diffuse out in immunity experiments, but it appears that this method may be diverted to other uses. I have found the method excellent. Harris gives a brief history of previous attempts to make such sacs on the ends of glass tubing.

CHARLES S. SHOUP

VANDERBILT UNIVERSITY

SPECIAL ARTICLES

ADAPTATION OF RICE TO FORTY CENTURIES OF AGRICULTURE

THE late Professor F. H. King in his book "Farmers of Forty Centuries" depicts the high level of crop production maintained for many centuries in some of the densely populated areas of oriental countries. Without the use of mineral fertilizers, depending almost entirely on occupational offal for purposes of soil improvement, Asiatic countries have maintained rice production in many sections sufficiently high to support their teeming millions. Various has been the comment or "explanation" on this phenomenon that appears as a paradox in the maintenance of soil fertility compared to the exhaustion of the soil by continued cropping of land to the cereals of occidental countries if practiced without fertilizers. Although the culture of rice (paddy) differs from that of wheat and barley in that the fields are usually submerged, the quantity of water applied annually usually does not contain sufficient nutrients to replace those taken from the soil by a normal crop of wheat or barley.

Results obtained in investigations to determine the smallest percentage of certain elements that can obtain in mature plants appear to throw light on the phenomenon of large yields of rice from lands cropped to this plant for many years continuously. The method employed in these experiments was to have test plants absorb varying quantities of a given element or elements by growth for varying lengths of time in a complete nutrient solution, subsequently

[1] Sartory, A. "Guide des manipulations de mycologie parasitaire," p. 100. Paris. Undated.

[2] Diehl, W. W. SCIENCE, N. S. 69: 276. 1929.

transferring them for the completion of growth into a culture medium devoid of the element for which the minimum was to be determined, but containing all others required for growth. By withholding absorption of the given element during the latter growth periods of the plant, data were obtained as to the maximum growth plants could make for a given quantity of an element absorbed during the early growth period. The identity of the same percentage of element in increasing magnitudes of yield and corresponding to increasing quantities of element absorbed was evidence that the maximum yield per unit quantity of element absorbed was obtained. The maximum yield of plant is the reciprocal to the minimum percentage of element that can obtain in the mature plant.

The nutrition of rice was studied with that of other cereals in the manner indicated above in order to obtain minima for various elements. Data were obtained as to the length of time (in terms of growth phase) elements were required. Furthermore, data were also obtained as to the length of time required for utilization of given quantities of materials after they were absorbed. The experiments are to be fully reported elsewhere, but brief account is given at this time as it appears that the data throw some light on the phenomenon of high yields of rice maintained for many years in oriental countries.

While chemical analyses are to be made on an array of varieties of rice treated to obtain the minimum for various elements required from the soil, nevertheless the results of the physiological experiments indicate that these will be very low for calcium, magnesium, phosphorus and sulphur. For example, seedlings grown initially in a complete nutrient solution for several weeks until they attained three grams dry weight per plant increased from eight to ten fold (dry weight) at maturity in a solution of KNO_3 only but containing iron. Similarly, seedlings grown initially four weeks in a complete nutrient solution and subsequently transferred for the completion of growth to culture media each devoid of one of the following elements—calcium, magnesium, phosphorus and sulphur —increased in weight from eight to fifteen fold at maturation. But seedlings grown initially for varying periods of time up to three months in complete nutrient solution upon transfer into media each devoid of one of the following elements—potassium, nitrogen and iron—produced markedly less crop at maturity than did any of the above treatments, or that of cultures grown entirely in a complete nutrient solution. Well-filled grain, but varying as to quantity depending on treatment employed, was produced from all treatments except those designed to determine the plant's requirement for iron. The absence of this element in available form in the media for relatively short periods as compared to that of other required elements was decidedly harmful to the growth of rice.

The complete nutrient solution used for the initial growth of rice was composed of equal concentrations of KH_2PO_4, $Ca(NO_3)_2$ and $MgSO_4$, together with a trace of boron and manganese (each one p.p.m.) and iron supplied as tartrate. The experiments were thus designed in the belief that all the above-named elements were essential for the growth of rice, but the unexpected good yields obtained of fully developed plants grown four fifths of their lives in media devoid of one to four of the already indicated elements suggest the advisability of reconsideration of the evidence extant that rice requires the same elements for growth as does wheat or barley. While the results of the experiment did not prove that any one of the elements in the complete nutrient solution was unessential, they nevertheless did prove that if all were essential, exceedingly small, or relatively unimportant quantities, considered as fertilizers, of all elements named with the exception of potassium, iron and nitrogen were sufficient to produce large yields of rice. It is the markedly low minimum of calcium, magnesium, phosphorus and sulphur in the mature plant, different in each of the differentiated products—grain, straw, roots—that is cited as evidence of low requirement for these elements and is explanation for the maintenance of high yields from continuous cropping of land to rice without any apparent marks of soil exhaustion. It is held the data obtained show that the production of large yields of rice is not dependent on soil rich in the elements named. Comparison of the requirements of wheat or barley for these elements with that of rice indicate that the latter plant would produce large crops planted in soils which would be relatively (and in some cases practically) infertile to wheat or barley.

In addition to these features of rice, several others may be mentioned in view of certain conceptions concerning the nutrition of this plant. Ten types of markedly different nutrient solutions were used and several hundred cultures were grown to maturity with nitrates as the only source of nitrogen available. The yields in many instances were comparable to those of representative plants grown in the field producing large crops. Ammonium salts, contrary to the prevailing view, are not necessary for rice production in nutrient solutions or in soil as proven by Bartholomew[1] in a recent publication. The failure of investigators to obtain normal development of rice in nutrient media containing nitrate, and devoid of ammonium ions, appears to be due to the inavailability of the iron used, although the form used would be read-

[1] R. P. Bartholomew, "The Availability of Nitrogenous Fertilizers to Rice," *Soil Sci.*, 28: 85–100, 1929.

ily available to wheat or barley in such media. Another feature observed was that related to the conditions necessary for grain production. Repeated failure to obtain grain from apparently normal plants was explained in the condition necessary for the fertilization process to function. It was found that the diurnal changes in temperature and humidity play very important rôles in the process. Rice plants require dew or a fairly saturated atmosphere for pollination to proceed properly, and the absence of dew on the plants, although grown in water in the greenhouse, was found to be the cause of the failure for rice to set grain in the case above mentioned.

W. F. Gericke

Laboratory of Plant Nutrition,
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THE MORPHOLOGY OF HAEMOPROTEUS LOPHORTYX SP. NOV.

Examination of 312 native quail in California showed that 45 per cent. of the birds were parasitized with a sporozoan, the gametocyte stages of which were to be found in the red blood cells of the birds.

The parasite, which belongs to the genus *Haemoproteus,* differs from *Haemoproteus columbae* Celli and Sanfelice of the pigeon and all other described forms. It is found in *Lophortyx californica* Shaw and all other species and subspecies of the genus *Lophortyx* inhabiting California, including Santa Catalina Island. It is herewith described as *Haemoproteus lophortyx,* the description being based largely upon the morphological characters of the mature gametocytes as they appear when the dried films are fixed with methyl alcohol and stained with dilute Giemsa's azur-eosin.

The diagnostic characters are as follows: Mature male gametocytes: Form and size: halter-shaped, partially encircling nucleus of blood cell but not in close contact with its nuclear membrane. Along greater part of its length, parasite extends out to periphery of blood cell. Diameter one and one half to two and one half microns; length up to eighteen microns when curving is taken into consideration. Both ends uniformly rounded, but the end containing the nucleus slightly broader. Instances not rare of the parasite completely filling the space formerly occupied by the cytoplasm of the host cell, in which case both ends of the nucleus-encircling gametocyte in contact.

Nucleus: elongate, ovate, almost always nearer to one end of the gametocyte, its broader end being nearer to the end of blood cell. Staining reaction, pale pink. Average size, one and one half by four microns. Becomes more diffuse and much larger, filling three fourths of volume of cell just preceding gametogenesis. Karyosome usually visible.

Cytoplasm: pale, almost hyaline.

Vacuoles: indistinct and diffuse, often a large one near one end of gametocyte with ring of pigment granules around its periphery.

Pigment granules: minimum number, eleven; maximum, thirty-nine; average, nineteen, with tendency to be deposited in two more or less terminal groups with a few scattered granules in between. Shape, from spherical to oval or rod-shaped. Size, from two tenths to eight tenths microns in greatest diameter. In fresh diluted blood, of carbon black appearance; in stained preparations, brownish. All granules highly refractive.

Mature female gametocytes: Form and size: like male gametocytes, halter-shaped encircling nucleus but not closely applied to nuclear membrane. Greater tendency for both ends of gametocyte to come into contact around nucleus of blood cell than in case of male gametocyte, in which case parasite loses characteristic halter-shaped appearance and fills entire space between nucleus and periphery of erythrocyte. Measurements in general same as for male gametocyte but tendency to produce greater hypertrophy of blood cell, especially when more than one gametocyte present in cell.

Nucleus: spherical to oval, more centrally located than in male gametocyte, average size up to one and one half or two and one half microns in the greater diameter. Staining reaction dark pink to red. Karyosome distinct.

Cytoplasm: staining reaction much darker blue, reticular appearance apparent.

Vacuoles: usually present, from one the size of the nucleus to two or more smaller ones irregularly placed.

Pigment granules: minimum number, fifteen; maximum, fifty-two; average, twenty-four. Tendency to be grouped less pronounced than in the case of the male gametocyte.

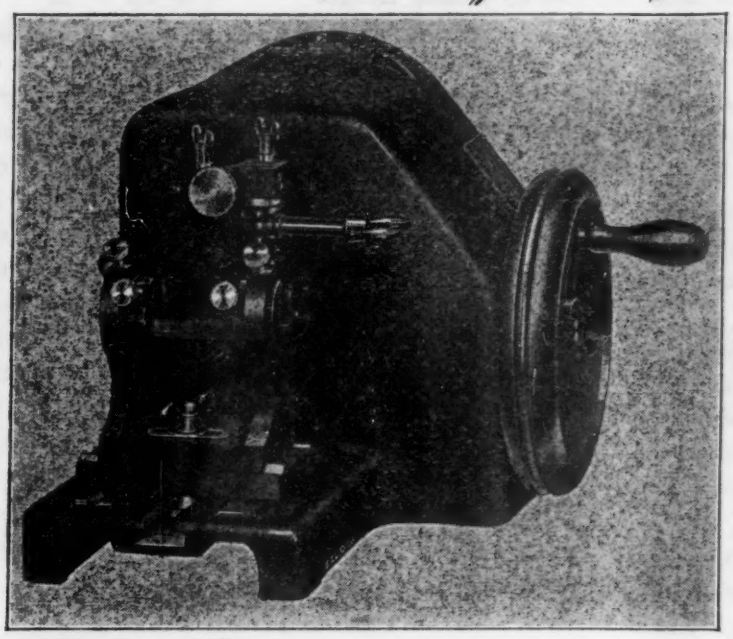
Experimental work has demonstrated that *Lynchia hirsuta* Ferris, an ectoparasitic louse fly, is responsible for transmitting the parasite from quail to quail. Transmission is biological, the sexual cycle of the parasite taking place in the fly.

Ordinarily a parasitized quail seems to be little inconvenienced, but numerous cases have been observed where the infected bird was weak and thin. Five fatal cases have been studied, the death of the birds being preceded by marked anemia due to the destruction of the red blood cells by the parasites.

The study of this parasite and its effect on the host is of especial interest since the California Valley quail is California's most prized game bird.

Earl C. O'Roke

University of Michigan



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SCIENCE NEWS

Science Service, Washington, D. C.

THE 200-INCH TELESCOPE OF THE CALIFORNIA INSTITUTE

TELESCOPIC power ten times as great as that given by the 100-inch reflecting telescope of the Mount Wilson Observatory, now the largest in the world, will be at the disposal of astronomers when the 200-inch reflector of the California Institute of Technology is completed. It will penetrate three times as far into space as the 100-inch, and bring into view a globular region of space thirty times the volume of that reached by present-day telescopes.

Work on the new instrument is now under way. A model of the telescope, based on a design that has been accepted tentatively, but may be greatly altered after further study, was placed on exhibition on October 19 at the building of the National Academy of Sciences in Washington.

Two miniature figures, on the same scale as the model, indicate the size of the finished instrument if this design is finally accepted. It will be about 85 feet high when pointing near the zenith, about the same height as a seven- or eight-story office building. The tube is supported in a fork, so that it may be pointed to any part of the sky. The fork is arranged to turn in a direction parallel with the axis of the earth. A powerful clock-drive will turn the instrument around this axis once a day, thereby keeping it pointed to the stars as they move across the sky. This arrangement is the same as in the usual equatorial mounting for astronomical telescopes.

In the present issue of *Harper's Magazine*, Dr. George Ellery Hale, honorary director of the Mount Wilson Observatory of the Carnegie Institution of Washington and chairman of the observatory council of the California Institute of Technology, describes the progress of the work on the telescope since it was started a year ago.

No actual construction work on the telescope proper has yet begun, but much necessary preliminary work has been accomplished. A tentative design for the telescope has been worked out. Plans have been completed for the astrophysical laboratory on the Pasadena campus, of the California Institute, which will be the headquarters of the astronomers who will use the telescope, measure the photographs taken with it and interpret them with the aid of laboratory experiments. Plans have also been made for the instrument shop where the smaller telescope parts and many accessory instruments will be constructed, and for the optical shop, where the huge mirror will be ground and figured. While these plans were being drawn, Mount Wilson astronomers have been engaging in a survey of a dozen possible sites for the new instrument.

Dr. Hale emphasizes the importance of choosing the best site for the telescope.

"We observe the stars from the depths of a turbulent atmosphere," he says, "which not only scatters and absorbs much of the light that reaches its upper levels, but so irregularly refracts the portion transmitted that the rays falling on the various parts of a large lens or mirror are rarely or never combined into a sharply defined and perfectly steady image.

"By selecting a site of high altitude, above the denser and more disturbed portion of the atmosphere, in a region but little affected by clouds and storms, we may greatly reduce these difficulties. In fact, the conditions on Mount Wilson are so favorable that on a very large proportion of the nights in the year the 100-inch Hooker telescope gives us a gain in light-collecting power over the 60-inch telescope fully in proportion to its greater aperture.

"The use of the larger instrument has thus resulted in many fundamental discoveries beyond the range of the smaller one, and has more than justified our most sanguine hopes. Moreover, we have direct observational evidence that on Mount Wilson a 200-inch telescope could be depended upon to show a further gain, in keeping with its increased size. The probabilities now are that we can find a still better site within a short distance of Pasadena."

THE ETHER DRIFT

SCIENCE still must answer the great and fundamental question: "Is there an ether?" And despite the many feats of the Einstein theories of relativity in explaining and predicting observed facts of physics, such as the way the planet Mercury moves in its orbit, they are seriously menaced by having one of their foundations pulled out from under them.

For Professor Dayton C. Miller has reported to the Optical Society of America meeting at Ithaca that he has during the past year laboriously repeated the ether drift experiments that he has been making during the last nine years in a Cleveland laboratory and on high Mount Wilson in California.

Again he finds an observed effect in the light path of his apparatus such as would be produced by a relative motion of the earth and the ether of about ten kilometers (six miles) per second. This is the same result that Dr. Miller has obtained during the past few years. In 1925 his paper on this work won the annual prize of the American Association for the Advancement of Science. This continued ability to obtain the same results over a period of years, whether the apparatus is at normal level in Cleveland or on a California mountain, makes Dr. Miller's results all the more important.

Nor does Dr. Miller feel that his experiments repudiate the famous Michelson-Morley experiments on ether drift performed in 1887. Prevalent opinion holds that this historic test showed that there is no ether drift, that there is no something filling all space, and it was upon this interpretation that Professor Albert Einstein based his special theory of relativity when he enunciated it in 1905. But Dr. Miller, studying the results of his latest experiments performed this year on the campus of the Case School of Applied Science, only about 300 feet from the location of the original Michelson-Morley interferometer of 1887, finds that his results showing the solar system moving through space "fully agree with and confirm the

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original Michelson-Morley observations, although the present interpretation is different.''

In the 1887 Michelson-Morley experiment there was discovered a slight difference in the time that it took light to travel over two paths, one at right angles to the other. But this was attributed to experimental errors, to those slight deviations that enter into all observations. Dr. Miller, by performing hundreds of experiments and by improving the details of the ether-drift interferometer, has by his results demonstrated that the observational differences of the original experiments and his many later tests are real and not due to error in the apparatus. Such refinements as shock-absorbing pads on the supporting piers and extreme precautions to eliminate temperature differences were taken in this year's experiments. The interferometer uses the interference of light waves to measure far more accurately than any mechanical means. Dr. Miller's instrument gives numerical results reliable to the hundredth part of a wave-length of light, although the length of the light path is 130,000,000 wave-lengths. He can detect a relative motion of earth and ether a twentieth that which he actually observed.

The discovered motion of six miles a second is not a mere earthly phenomenon, but a cosmic one. It is fixed with relation to sidereal time, that is, it is toward a fixed place in space. The earth and its millions and the whole solar system is rushing, Dr. Miller declares, ''toward the point having a right ascension of 17 hours.''

How are the scientists to reconcile with their theories this well-tested motion that the ether-drift experiments demonstrate? Dr. Miller says: ''It seems impossible at the present time to account for a cosmic effect of this small magnitude and it will be necessary to continue these experiments and to coordinate them with others before an acceptable theory can be propounded.''

THE SUPERSONIC SUBMARINE FINDER

RUMORS that the United States and other powers are willing to abandon submarines because a sure means has been perfected for locating them under water, even when ''sleeping'' on the bottom, seem to be without solid foundation. Information available indicates that the various types of supersonic listening gear, while moderately effective, are of too short range to be reckoned as generally effective from a military view-point. If, therefore, submarine construction is abandoned or restricted in the immediate future it will be a deliberate move in a peace program rather than the abandonment of an arm because it has lost its fighting value.

Statements have gained circulation lately that the British Admiralty has perfected a device for locating submarines at a distance. Such a device, if perfected, would without doubt mean the end of undersea fighting craft, for such boats are easy to destroy once they are located. But the range of the listening gear used in all navies of the world so far as known is to be measured in mere hundreds of yards rather than in miles, so that unless the sea were literally peppered with scout boats many submarines would be bound to escape detection.

Most of the locators of ''silent'' submarines known to military students at Washington depend on the propagation through the water of beams of sound-waves so short as to be inaudible to human ears—the so-called supersonic or ultrasonic waves. These can be produced from electrically excited crystals of quartz, somewhat similar to those used in radio broadcast stations for frequency control, but larger. These waves differ from ordinary sound-waves in that they can be directed in a comparatively narrow beam, like the rays of a searchlight. They reflect as echoes from solid objects, and parts of these echoes are picked up by the listening gear on scout ships, amplified and interpreted by observers. Similar devices, using audible sound-waves, have been used for a long time in the well-known sonic depth-finding apparatus.

Work on supersonic submarine locators began during the world war, and has been carried on ever since, particularly by France, Great Britain and the United States. During the war their information was more or less pooled, but since then the researches have continued independently in each country. It is believed that progress in this country has been about equal to that abroad, although necessarily most of the information about the technical details of the apparatus is kept confidential.

From time to time wild stories get into circulation crediting supersonics with destructive power verging on the supernatural. These seem to be based on the experimental work on extremely short-length supersonic waves carried on by Professor R. W. Wood, of the Johns Hopkins University, and Alfred L. Loomis, in the latter's private laboratory at Tuxedo Park, N. Y. This work, following observations made by Professor Wood in the laboratory of P. Langevin, at Toulon, during the war, has shown that it is possible to kill small animals and microscopic plants with ''rays'' of supersonic waves in water. But they do not kill anything bigger than a tadpole or a goldfish, and they are never used in more than half a pint or so of water. So that using them to sink a submarine in the ocean, or to kill her crew at a distance of a mile, is quite out of the question. The significance of the supersonic researches of Professor Wood and Mr. Loomis is not military, but purely scientific.

TRACHOMA AND BLINDNESS

THE chief cause of the nearly two and one half million cases of blindness existing in the world to-day is trachoma, according to a statement made by Lewis H. Carris, managing director of the National Society for the Prevention of Blindness, on his return from a world conference on blindness held at The Hague.

This disease is found in nearly every part of the globe, but it is at its worst in Oriental countries. It is most prevalent in Egypt and along the borders of the Mediterranean Sea, in Palestine, China, the Balkan States, India, the hot sections of Brazil and in our country among the inhabitants of the Appalachian and Ozark Mountain districts and among American Indians.

Trachoma is a highly contagious disease. The roller towel has been the cause of many epidemics of the dis-

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ease in industrial plants. A common family towel is also a potent spreader of the disease among members of the same household. Poverty, crowding and unsanitary living conditions are important factors in the contraction and spread of trachoma.

The disease causes redness, painful inflammation and granular growths, looking something like sago, within the lids. These irritate the cornea, producing ulcers and later scars. The scar formation may produce an opaque layer covering the pupil which results in loss of sight.

In individual cases the disease may be checked by proper treatment, but trachoma is so wide-spread that it can not be entirely controlled until more is known of its cause. Dr. Hideyo Noguchi, working at the Rockefeller Institute for Medical Research, thought that he had found the organism or germ causing trachoma. Since his death the work has been continued, but further results have not yet been announced. Other investigators have considered diet a causative or predisposing factor.

The United States has for many years refused admission to immigrants showing symptoms of trachoma. The U. S. Public Health Service has been conducting extensive studies of the disease in the sections of this country where it is prevalent.

The other major causes of blindness are venereal diseases, babies' sore eyes, smallpox, glaucoma, congenital defects and accidents.

THE DEVELOPMENT OF INFANTS

PSYCHOLOGISTS studying the behavior of young children have succeeded in giving a baby training that would alter the course of its development and yet they have been able to see what it would have been like if it had never been trained. This magic has been brought about by the Yale Psycho-Clinic, where Dr. Arnold Gesell and Dr. Helen Thompson have observed identical twin girls from the age of one month up to the age of eighteen months. Reporting their unusual experiment in the *Genetic Psychology Monographs,* the psychologists say that it is doubtful if prolonged search could have secured for comparative study twins more extensively and profoundly alike than these. The blue-eyed blonde babies respond with remarkable similarity of behavior to almost any situation. In refusing or objecting, each twin's gesture is to turn the body slightly to the right and bend the left arm across the chest. When placed back to back and observed for several hours, their manner of handling a bell, spoon and other objects was strikingly similar.

For six weeks the psychologists gave one twin girl, T, a chance to practice climbing a set of five steps every day. Meanwhile, the other twin, C, had no such opportunity to learn the new activity. In the first three weeks of climbing lessons Twin T had to be frequently assisted. At the end of six weeks, when she was 52 weeks old, she climbed the steps in 26 seconds and was an enthusiastic climber. Yet when Twin C was introduced to the steps at the age of 53 weeks, she proceeded to climb the staircase without training or aid, taking only 45 seconds. At the age of 56 weeks T was climbing the steps in 11 seconds and C in 14.

Twin T was also given practice in handling cubes, the psychologists report, but her added early experience did not give her any advantage when Twin C was presented with three little blocks to bang with and to pile on top of one another.

The experience of the twins shows, according to Dr. Gesell and Dr. Thompson, that a child begins to climb and to build towers with his blocks when his nerve structures are ripe for such activities. Exercise may not even hasten the actual appearance of such reactions in a young child. The experience gained by early practice tends to be supplanted or modified by the process of the child's maturation. If it were not so, the infant could scarcely grow. Twins identically alike offer a promising field for psychologists to study the difficult problems of human growth.

ITEMS

WHEN a farmer plants a clover crop on a piece of poor land for the purpose of enriching it, and later on puts the field into some other crop, he is only duplicating a process that happens without human assistance wherever there are raw or impoverished soils. This is indicated by the results of observations by Dr. Elmer Campbell, of Transylvania College, published in the scientific journal *Ecology.* Dr. Campbell studied a series of raw gravel exposures in Indiana and also a number of exhausted and abandoned fields in various parts of the South. He found that in all cases the larger proportion of legumes in the total vegetation was found on the poorer soils, and that as legumes increased the nitrogen content they were gradually replaced by other wild plants. For instance, on the Indiana gravel he found the plant population to be 100 per cent. sweet clover on a three-year-old exposure, but on a ten-year-old strip sweet clover made up only 20 per cent. of all the plants present. In the South the predominant wild legume of poor lands was lespedeza.

AN automobile dumbwaiter is the newest suggestion for solving the parking problem. As demonstrated by Westinghouse engineers recently, the car is driven onto a platform, a button is pressed, and the car is whisked up out of sight. An empty platform appears for the next car. When the owner wishes to retrieve his car, he presses the proper button, and the car is immediately delivered to him at ground level, ready to be driven away. Occupying as much space as a small double garage, the new machine can be built in any capacity desired, it was stated, and installed in old or new buildings.

A WAY to irradiate chocolate so that its flavor is not impaired has been discovered by two Austrian scientists, Drs. S. Reid and H. Krasso. Rats fed on this chocolate gained in weight. Patients enjoyed it and showed improvement in appetite and general condition and a gain in weight. The chocolate was fed as milk chocolate and as a beverage made with milk. Most of the patients to whom this chocolate was given were suffering from tuberculosis. A few suffering from secondary anemia showed improvement in the condition of their blood. Dr. Krasso also suggests that irradiated chocolate might prove valuable in the treatment of diseases of the bones, such as rickets.

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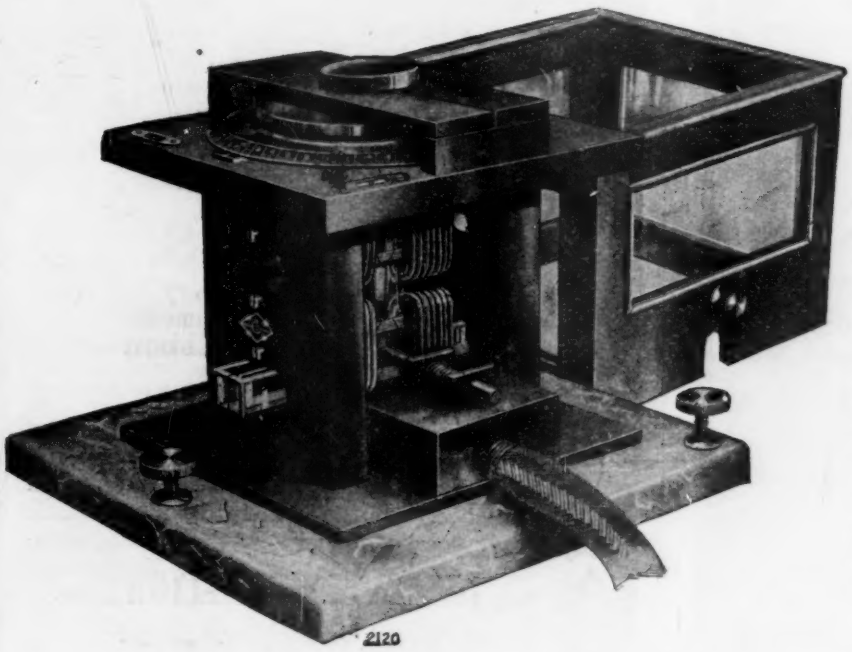

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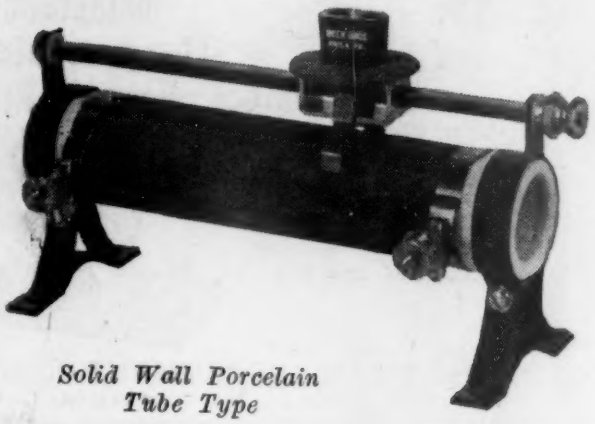

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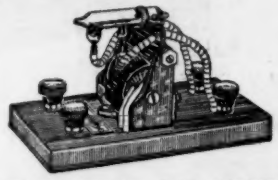

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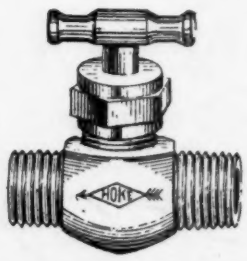

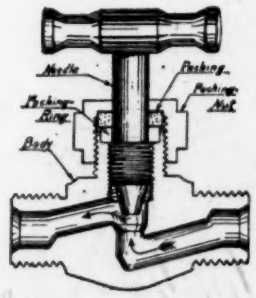

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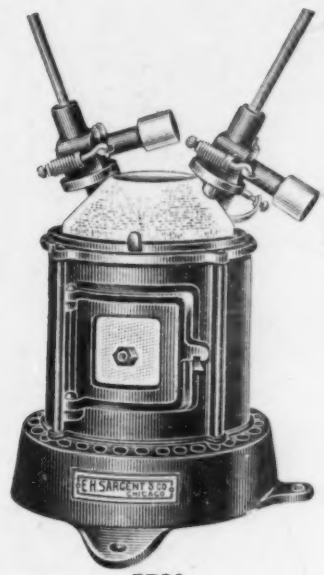
22 Albany St., New York City

ELECTRIC ARC FURNACES
FOR LABORATORY USE

5726



5730

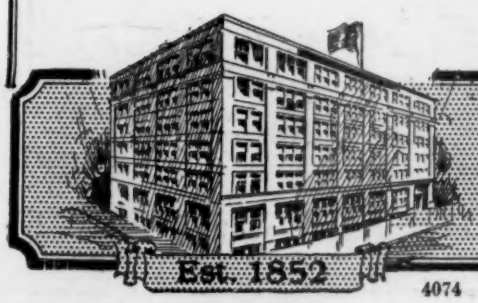
Furnace No. 5726 is for use in work requiring temperature up to 3100° F. such as the fusion of ashes, gold, silver, nickel, copper, brass, iron and other metals in a non-oxidizing atmosphere. It will melt quantities up to 3 pounds of metal depending on the type of metal used and requires 110 volts, 15 to 30 amperes or 45 amperes for especially rapid melting, either alternating current of any cycle or direct current. The furnace consists of a refractory lining moulded in the shape of a crucible and surrounded by an insulating lining held in position by a sheet iron jacket. The heating chamber will accommodate a plumbago crucible measuring 3⅝ inches in height and 3⅛ inches in diameter at the top. The lid of the furnace is made of the same refractory material as the lining and is attached to an iron support in such a manner as to permit it being raised and swung aside from the body. In the bottom of the heating chamber is a carbon electrode which makes contact with the plumbago crucible, thus becoming one terminal of the arc. The other terminal is likewise of carbon and is situated in the lid of the furnace and is so constructed as to allow its adjustment to the character of the material being melted. A Cutler-Hammer Reactance Grid is used to balance the arc. The maximum current consumption of the furnace being 45 amperes, a suitably fused line must be supplied to convey current and a knife switch is needed to disconnect the current.

Complete with Cutler-Hammer Reactance Grid and six carbon electrodes. For 110 volts D.C. or 110 volts A.C. single phase..... $125.00

Furnace No. 5730 is similar to the above, but equipped with two carbon electrodes adjustably mounted in the lid forming a horizontal arc above the material in the crucible and permitting the use of non-conducting refractory crucibles. The maximum temperature obtained is 4200° F. Entrance to the heating chamber is effected through a door in the front. The heating chamber accommodates a crucible up to 3⅞ inches in height and 3⅛ inches in diameter at the top. The maximum current consumption is 45 amperes.

Complete with Cutler-Hammer Reactance Grid and six carbon electrodes. For 110 volts D.C. or 110 volts A.C. single phase..... $125.00

Prices on furnaces for other voltages upon application.



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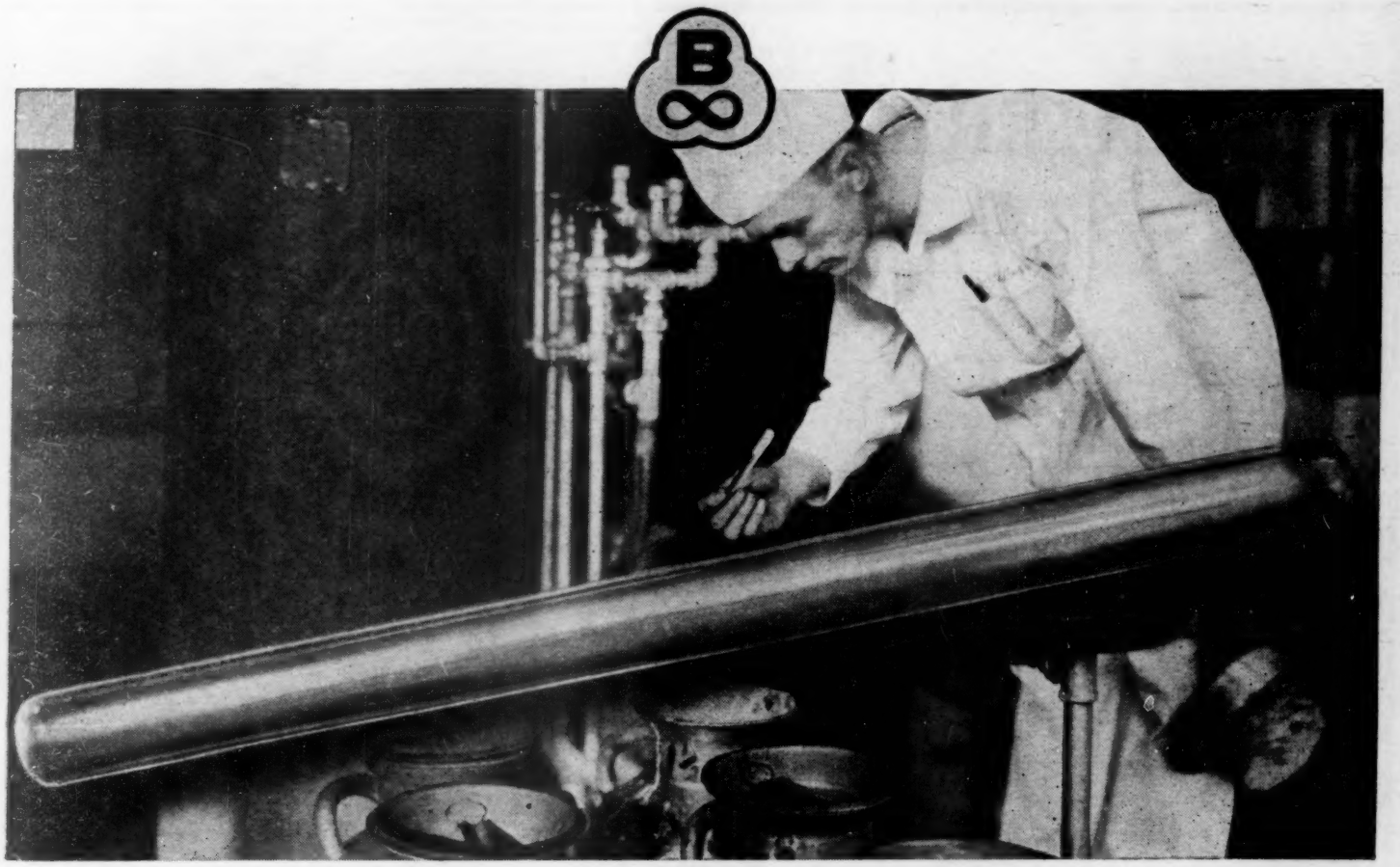

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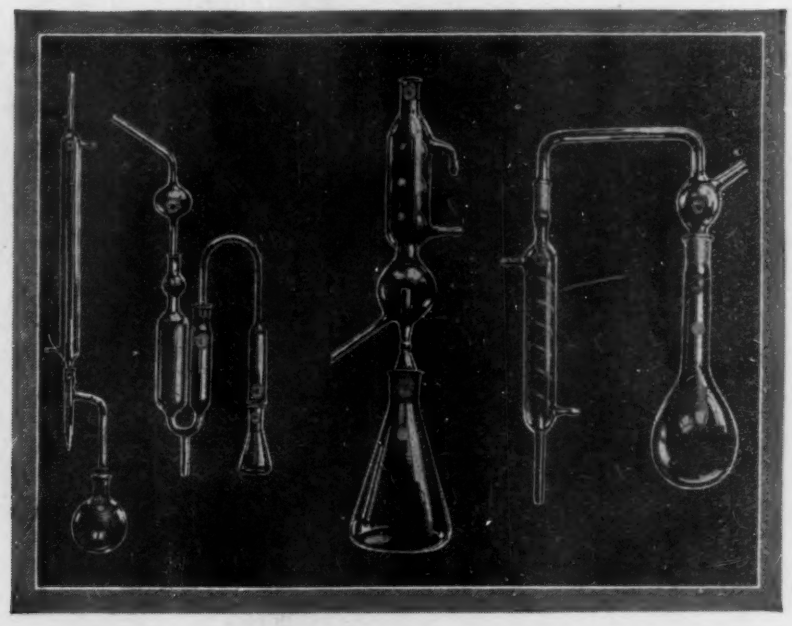

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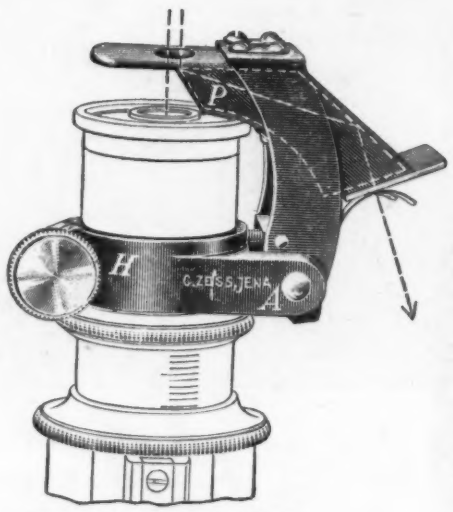

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